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ABSTRACT

The 1999 WebNet conference addressed research, new developments, and experiences related to the Internet and World Wide Web. The 394 contributions of WebNet 99 contained in this proceedings comprise the full and short papers accepted for presentation at the conference. Major topics covered include: commercial, business, professional, and community applications; educational applications; electronic publishing and digital libraries; ergonomic, interface, and cognitive issues; general Web tools and facilities; medical applications of the Web; personal applications and environments; societal issues, including legal, standards, and international issues; and Web technical facilities. An author index is included. Most papers contain references. (MES)

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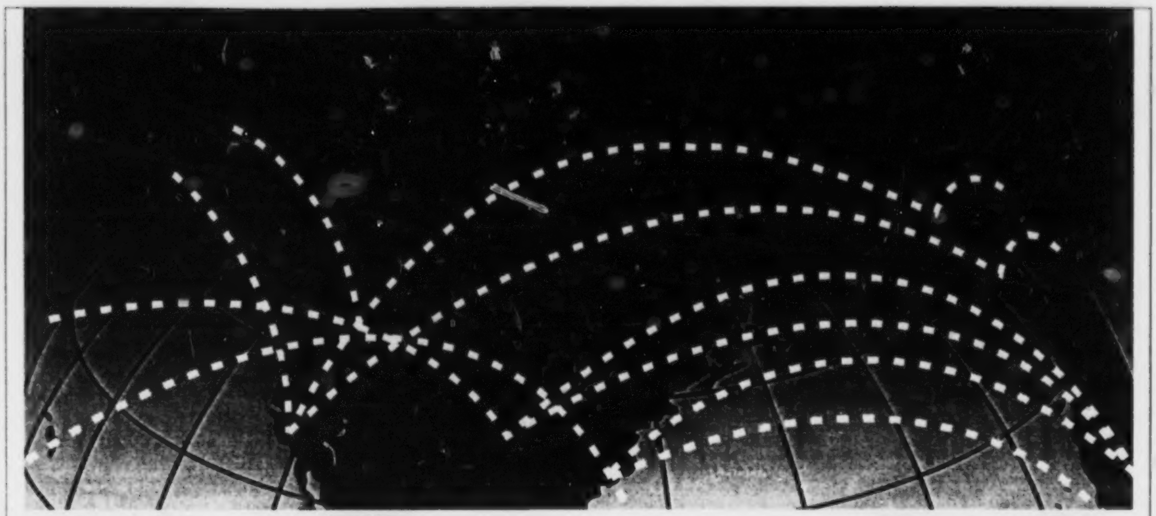

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Preface

On behalf of the Program Committee and AACE, it is our pleasure to present to you the proceedings of the fourth WebNet conference – WebNet 99. This conference addresses research, new developments, and experience related to the Internet, Intranets, and Extranets.

The 394 contributions of WebNet 99 presented in this volume consist of the Full and Short Papers accepted for presentation at the conference from a collection of 912 submitted from 49 countries. All submissions were carefully reviewed by at least three members of the Program Committee and their recommendations used for selection. Borderline cases were reviewed at a special Program Committee meeting where appropriate decisions were made based on re-reviews.

Of the accepted contributions, 18 were considered outstanding based on reviewer's scores and comments. These outstanding papers represent the top 4.5% and are acknowledged in the table of contents. Authors of outstanding papers will be invited to submit extended versions of their papers to the *WebNet Journal*.

The coverage of the contributions is very wide, which is one of the features that distinguish the WebNet series of conferences from others that focus on more specific areas. Our intention has been to provide an application oriented conference - a meeting place of developers, researchers, practitioners, and users - as a forum wherein persons from disparate but related fields can meet and learn about new developments that impact their activities.

This volume contains position papers by leading experts in the field; descriptions of ideas that are on the borderline between an idea, a prototype, and products; reports on concrete applications of the Web and its impact on various aspects of life; and considerations as to how society might adjust and react to the resultant changes.

The major areas covered at the conference and presented in this volume include:

- Commercial, Business, Professional, and Community Applications
- Educational Applications
- Electronic Publishing and Digital Libraries
- Ergonomic, Interface, and Cognitive Issues
- General Web Tools and Facilities
- Personal Applications and Environments
- Societal Issues, Including Legal, Standards, and International Issues
- Web Technical Facilities.

These general areas have been divided into 56 more specialized topics.

In addition to the papers included in this volume, participants in the conference heard leading experts present Keynote and Invited lectures; participated in tutorials, workshops, small-group discussions, and poster sessions; and had a chance to see demonstrations of various items of interest. The conference was preceded by a minicourse and followed by two days of tutorials and workshops. This printed record cannot show all aspects of this highly interactive, media-rich Web meeting, but it does convey the depth and breadth of the conference.

Let us take the opportunity to urge you to plan now to attend WebNet 2000 in San Antonio, Texas, Oct. 30 - Nov. 4. To attend and observe the WebNet series is one of the best ways to stay current with the rapid and intriguing developments of the Web. Periodically check **http://www.aace.org/conf/webnet/** for information.

All of us realize that the Web is coming to have a major impact in international society. There is increasing confusion and concern on the part of many, in a wide variety of fields, as to what the implications and possibilities of the Web are. We all, as persons immersed in the topic, have a responsibility to explore, and clarify for others, the practical possibilities. We urge that you, and those with which you are in contact, consider these matters and reflect that thinking in your participation in WebNet 2000.

In closing, we would like to thank all authors for submitting their work, and all members of the Program Committee, listed on the following page, for their cooperation and time spent reviewing submissions. Special appreciation is extended to Gary Marks (AACE), who is one of the main driving forces behind this volume as well as the WebNet series of conferences, and the AACE staff who contributed so much to the success of the conference.

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Internet Technologies, Applications & Issues
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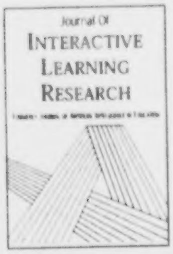
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International Journal of Educational Telecommunications

(IJET) ISSN# 1077-9124 *Quarterly*

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Information Technology in Childhood Education Annual

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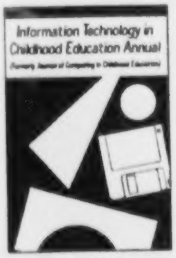
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ICCE is an annual event focusing on a broad spectrum of interdisciplinary research topics concerned with theories, technologies and practices of applying computers in education. It provides a forum for interchange among educators, cognitive and computer scientists, and practitioners throughout the world, especially from the Asia-Pacific region.

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ICLS, held biennially, is designed for researchers, developers, practitioners, consumers, and policy makers to share experiences and insights on fostering effective learning to serve real-world needs. Represented are a diverse group from the fields of cognitive science, multimedia, training, education, and artificial intelligence.

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Keynote Speakers

Utopia, Oblivion, or Muddled Compromise? Fantasies and Realities about the Coming Global Society (POWERPOINT SLIDES)

Nathaniel S. Borenstein
University of Michigan
USA

Utopia, Oblivion, or Muddled Compromise: The Coming Global Society and the Value of Info-Wilderness

We're all sick of pundits, but...

Internet pundits only say a few things anyway!

2 main Utopias, 2 dystopias

And a very muddy middle ground:

-- Probably most "right"

-- Certainly most pragmatic

-- Virtually inevitable

The real action is behind the scenes

We are not alone.

At least, not usually.

The new endangered species:

Independent, disconnected humanity

Preserve info-wilderness

(spaces free of the Group Mind)

My Life in the Group Mind

- I believe I have been living the future.
- Almost never a day off-net, 1980-1998.
- Email peaked at >1000 in 1994-95
- Lived in "wilderness" with family & modem
- Now struggling for identity off-net.
- Not everyone will have that luxury.

Where will the Internet take us?

Two Pipe dreams

- Paradise 1: Libertarian Anarchy (LA)
  - We've all heard the story
  - (with many variants)
  - A tough neo-Darwinism is helpful.
- Paradise 2: Centralized Democracy (CD)
  - Seemed semi-plausible not so long ago.
  - First-generation Cybernetic Utopia

Each Utopia Conceals a Dark Fear

- CD --> Centralized totalitarianism
  - Consider the 20th century
  - "1984" imagined in 1948
  - Consequent fear long-since internalized.

Each Utopia Conceals a Dark Fear

- LA --> Mercantile oligopoly
  - Any worms in the apple?
  - Q: "good" == "wealth-maximizing"?
- A troubling example: "free market" in content restrictions may promote ethical systems of wealthy elites.

The Evolving Middle ground

- **Power coalitions limit oligopoly, a little.**
- **Weak center limits totalitarian prospects**
- **80/20 international governance**
  - G7 -> "Binding Triad" hegemony?
- **Centrality required for certain purposes**
  - War crimes, Trade rules Environmental law....
- **The weaker the better, in most peoples' eyes**
- **Extreme example: ICANN.**
  - -- STILL need to diffuse power.

A Deeper Illusion: Human Control

- **Individual humans have limited control.**
- **Something more fundamental is changing.**
- **Collectivized nexus of planning**
- **The new conventional wisdom:**
  - -- BRANDING IS EVERYTHING
  - -- Eyeballs are gold.
- **Esther Dyson wins if the name ICANN survives w/authority.**

How did this happen?

- **Branding CW is true, but...**
- **It didn't always used to be like this!**
  - Branding as 20th century phenomenon.
  - Internet accelerates its importance.
- **Why the change? What's different now?**

Why does money flow to "eyeballs"?

- **Intelligence is collective (c.f. insects).**
- **Human group mind long-emerging**
  - (Earliest mechanism: myths)
  - (w/books: Jung, Campbell, etc.)
- **Modern info-tech makes it efficient**
  - Internet is most extreme, but TV, radio, etc. are a big part of it
- **The power of branding:**
  - Enlist small individual power into a branded (economically-directed) vision for the group mind
- **Is this good? We may never know.**

What's an Individual Human to Do?

- **Primarily: struggle for existence.**
  - Don't worry about the future of the net. Worry about your mortal soul.
- **Let the group mind plan its own future.**
- **The group mind needs us to flourish.**
- **We can be stewards of the material world.**

-- and –

- **We can preserve our individuality.**

Preserve Individuality by

- **Preserving Information Wilderness**
- **Keep a part of yourself off-net.**
- **Declare independence from the group mind**
- **Be conscious that it exists.**
- **Take time off for yourself.**
- **You're in Hawaii, but...**
  - How isolated are you?
  - How independent?
  - How free?

Some good starting points

Ban modems in wilderness areas.

Create Internet/media-free zones

in your community.

in your home.

in your life.

Be conscious of yourself:

off net: as an individual

on net: as part of a group mind

Both aspects of yourself

are different.

are valid/useful.

have specific needs.

The Bottom Lines

For me:

-- Two decades on the net is plenty.

-- Currently off-net 4-5 days/week.

For society:

-- Individual impact is minimal. (guru to crackpot overnight)

-- Group action can be effective (temporary issue-oriented coalitions)

For you, now:

-- The world's most isolated islands!

-- Get unplugged. You might like it.

Human Communication and the Design of the Modern Web Architecture

Roy T. Fielding, University of California, USA

A software architecture determines how system elements are identified and allocated, how the elements interact to form a system, the amount and granularity of communication needed for interaction, and the interface protocols used for communication. Software engineers often find the inspiration for architectural designs within natural systems. For example, life is frequently compared to a distributed object system, since biological systems are composed of components with individual identity and behavior, communicating through changes in the body chemistry. A similar analogy can be used to describe the modern Web architecture.

Human communication can be thought of as a distributed hypermedia system. The mind's intellect, voice+gestures, five senses, and imagination are all components in the system of human communication. A person thinks of what they wish to communicate, translates that into a representation which they believe will be understood by the intended audience, exchanges that representation using their voice, gestures, and reference to other representations, and then hopes that each person receiving the representation will interpret what was transferred in the same way as the originator. Using this analogy, we can explore the design of the modern Web architecture as it has evolved to meet the needs of resource identification, intermediate processing, large scale caching, content negotiation, and more efficient use of the network infrastructure.

For more information see: http://www.ics.uci.edu/~fielding/

All's WELL That Ends: The Origins and Future of Online Community

Steve Jones, University of Illinois at Chicago

This presentation is focused on the connections between online community and commerce/economics, particularly the rhetoric of community as it has been taken up by those in e-commerce endeavors. It makes the case that the most influential symbol for online community, the WELL (Whole Earth 'Lectronic Link) should be examined in light of sociocultural trends apart from Internet-related ones, most importantly those that began to shape the social mores of the Baby Boom generation in the late 1960s. Of particular importance is the borrowing of language and ideas from Sixties literature and song in subsequent structuring of community discourse. Examining the rhetoric of online community in this context will add a missing link to ongoing debates about the construction of online community. The presentation will conclude with a discussion of the consequences of telepresence and immersive technologies for online community.

For more information see: http://info.comm.uic.edu/jones

Escaping Entropy Death: Why The Web Works For Business

Simon Phipps, IBM UK Laboratories, UK

The world of computing is being revolutionised by the Web, Java and XML. This talk explains why. Expect clear ideas, interesting examples, humour and energy.

A new paradigm is breaking on the shores of the computing industry. Using agreed standards to complement rather than replace existing technologies, networked computing offers both businesses and casual computer users a new freedom to create effective computing solutions without damaging existing systems or creating future support liabilities. Based on technologies comonly associated with the internet (TCP/IP and web browsers), it is the Java software model that allows true power and flexibility to be delivered to solve business problems and increasingly to create interactive Web content. This presentation traces the history of the new paradigm, explains the truth about Java and the principles that make it the right model for business computing, and looks into the future of computing including connected devices and XML. The presentation is suitable for a general audience although technical questions are welcome.

More information can be found at http://www.ibm.com/developer/

Invited Speakers

Taking Hypertext Seriously: Scholarship and Storytelling

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Abstract: The artifactual form of books and journals undergoes continual change and refinement, as technologies and tastes change from generation to generation. As serious writing migrates from the printed page to the screen, the development of hypertext and of the World Wide Web has made these changes unusually clear and has often evoked an emotional, rather than a critical, response.

1. Form: Beyond the Shell

Chieko Yoshimura is not enjoying her first professional conference. The papers are fascinating, and travel is exciting. But the contents of her purse vanished sometime during the first day, and with it her passport, plane tickets, and credit cards.

Chieko Yoshimura arrived at the conference with a new degree and a new job. Her new job is at a new company, in a new industry. Her dad came from the Old World, her mom from the Third World, she lives in the New World. Chieko is really a very conservative young woman.

This morning, a speaker was discussing genre, style, and the evolution of the Web. She'd already started to copy down a slide about Chieko Yoshimura's remarkably frank and revealing memoir when two things occurred to her:

1) Chieko Yoshimura was a fairly unusual name, and the URL on the slide was all too familiar.

2) She hadn't actually done anything to her Web site in weeks, when she'd added a picture of her kitten. There was nothing frank or revealing, or even interesting, on her Web site.

She wondered how on earth she'd get net access, in Europe, without a credit card. Or a passport. Or a ticket home.

She rather hoped her dad hadn't figured out how to use WebTV yet, after all.

Our protagonist has lost an important codex book, her passport, but this *precipitating incident* [Laurel, 1991] need not cause irreparable harm. She is not a stateless refugee, and the artifact can be replaced. The distinction between serious writing and its artifactual form has been blurred by critics who confound a taste for literature with book collecting [Birkerts, 1994].

The relationship between serious writing and its outward form or *shell* merits closer study [Rau, 1999]. Unfortunately, much attention has been focused on debating whether hypertext is illuminated [Landow, 1997] or corrupted [Miller, 1998] by postmodernism (or, arguably, modernism [Aarseth, 1997]).

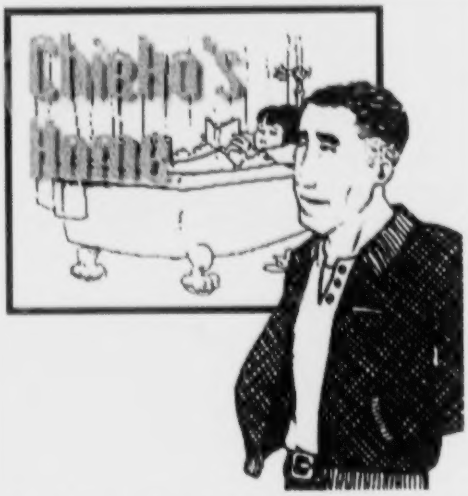
The hijacking of her home page raises a host of interesting issues. The convention that the putative author of a work is identical to an actual person evolved from protracted scholarly debates and contravened longstanding customs [Johns, 1998]. Rhetorical [Lanham, 1993] and stylistic [Furuta, 1995] customs are conventions, not natural law.

2. Beyond Usability

Jan, the speaker who described Chieko's home page, did not know she was in the audience, and his purpose was not merely to tell the audience that this particular literary object was a desirable commodity. Neither criticism and scholarship are merely consumer reports.

Much discussion of hypertext and of Web page design focuses narrowly on access and usability — on the needs of new, novice, or casual readers. The assumptions that transparency is the ultimate aspiration of nonfiction writing (Rosenfeld and Morville 1998) (but see (Lanham 1993)), and that immersion is the natural goal of storytelling (Murray 1997) (but see (Gaggi 1997)), are so common that they often become invisible.

But Jan had not set out to discover a Web page written by a young Asian-American businesswoman that stirred his soul and made him see the world a little differently. These were not the terms he had supplied to the search engine; he couldn't search for it, because he didn't know he wanted to. Similarly, had the page been clearly and sincerely labelled, he would have dismissed it instantly as irrelevant; only by artful disorientation, by cleverly playing upon (and subverting) his expectations, could the author successfully make her point (Landow 1995) (Bernstein 1998).



The slide Jan used in his talk, while embarassing to our protagonist, illustrates one of the common (but specious) objections to serious hypertextual literature. The *Bolter Test* [Bolter, 1991] objects that electronic books will be poorly suited to reading in bed or the bathtub, a concern that would be more pertinent if damp and sleepy readers were the aspiration of literature. Other common but ill-founded objections include eye strain from reading screens, format impermanence, loss of the sensual experience of ink and leather, and resemblance of computers to television [Moulthrop, 1989] [Miller, 1998] [Birkerts, 1994].

3. Literature and Economics

Jan's talk was recorded by several people in the audience, including Ted, one of the youngest attendees. Ted records everything; she routinely carries a video recorder, a digital camera, a minidisc audio deck, and a laptop computer. This record-making is not merely an archival gesture toward literary survival, as old age is not Ted's immediate concern. Rather, she uses the tools to change perspective, as a means of *remediation* (Bolter and Grusin 1999).

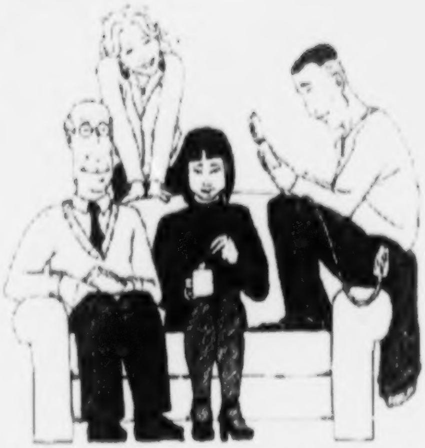
Ted, like many writers and scholars, creates primarily for herself. Rewards that accrue from publication may not be the motivation for discovery or creation, but literature and scholarship (like everything else) are bound in the pervasive network of relationships we call economics. If serious writing is payment-free, how will writers and scholars buy groceries? Dependence on the sponsorship of the state or the charity of the rich may resolve short-term funding problems, but only at the cost of restoring literature's medieval dependence on the patronage of princes and prelates. Confounding a free press and a press outside the economy is ahistorical and unsound [Golumbia, 1996].

4. This is not a hypertext

This is not a hypertext, nor is it a story. These are some sketches, fragments of stories and of arguments that might be. Nothing is resolved yet, but resolution is possible: by suggesting a dramatic problem, we imply its solution.

Skeptics sometimes assert that hypertext is incompatible with narrative or with coherent argumentation, believing that stories naturally begin at the beginning and that arguments proceed from premises to conclusions. Inspection of actual narratives and real arguments, however, reveals a much richer variety of structural patterns. Clarity often demands that we forego strict chronology to make causes and effects clear, or that we anticipate a conclusion in order to motivate an argument. Coherence is not merely sequence (Kolb 1994) (Kolb 1997).

Understanding hypertext requires thoughtful criticism of actual hypertexts, not merely to make purchase recommendations or to award tenure, but rather to understand how hypertexts communicate (Walker 1999) (Tosca 1999) (Joyce 1997) (Bernstein 1998). *A priori* reasoning about what hypertext might become, necessary and useful as this was in the era before actual hypertexts were available (Nelson 1982), can no longer substitute for examining the data.



What will happen to Chieko? Will she find her passport? How will she get home without it? And what's going home going to be like, after Jan (or someone) has made her a celebrity? How's she going to explain this to her department head? To her dad?

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Portions of this paper are fiction. Any resemblance to actual persons, living or dead, or to actual events, is coincidental.

References

Bernstein, M. (1998). Hypertext Gardens. http://www.eastgate.com/gardens/

Bernstein, M. (1998). Patterns of Hypertext. Hypertext '98, Pittsburgh, PA, ACM: 21-29

Bolter, J. D. and R. Grusin (1999). Remediation. Cambridge, MIT Press.

Gaggi, S. (1997). From Text To Hypertext: Decentering the Subject in Fiction, Film, the Visual Arts, and Electronic Media. Philadelphia, The University of Pennsylvania Press.

Joyce, M. (1997). "Nonce Upon Some Times: Rereading Hypertext Fiction." Modern Fiction Studies **43**(3): 579-597.

Kolb, D. (1994). Socrates in the Labyrinth: Hypertext, Argument, Philosophy. Watertown, Massachusetts, Eastgate Systems, Inc.

Kolb, D. (1997). Scholarly Hypertext: Self-Represented Complexity. Hypertext 97, Southampton, U.K., ACM: 29-37

Landow, G. P. (1995). Writing At The Edge. Watertown, Massachusetts, Eastgate Systems, Inc.

Lanham, R. A. (1993). The Electronic Word: Democracy, Technology, and the Arts. Chicago, University of Chicago Press.

Murray, J. (1997). Hamlet On The Holodeck: The Future of Narrative in Cyberspace. New York, The Free Press.

Nelson, T. (1982). Literary Machines. 1987, Mindscape Press.

Rosenfeld, L. and P. Morville (1998). Information Architecture for the World Wide Web. Cambridge, O'Reilly.

Tosca, S. P. (1999). The Lyrical Quality of Links. Hypertext '99, Darmstadt, ACM: 217-218

Walker, J. (1999). Piecing together and tearing apart: finding the story in *afternoon*. Hypertext '99, Darmstadt, Germany, ACM: in press

Computer Crime in the Net - The Case of the Virus

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POWERPOINT PRESENTATION

Computer Crime in Changing Times

75s: Classical Computer Crime - Mainframe Crimes

- Hacking, Sabotage, Computer Fraud, illegal use (..

85s: Post-Classics - Midrange Crimes

- Software Copyright Infringement, Software for Tax Evasion, Spying, Viruses

95s: Net Crimes

- Trojan Horses, Forgery of Electronic Signatures, Credit Card Fraud, Child Porns, Net Viruses

What is a Virus?

Selfreplicating Entity

Functions of a computer virus

- [Detect and kill AntiVirus]
- Search not infected target (EEPROM (?), boot sector, .com, .exe, .dll, .sys, macro-document, .java, ...)
- Replicate
- [Avoid Detection e.g. by Mutation]
- Activate Payload

Was Melissa unforeseen?

Morris Internet Worm 1988 (US v Morris, 928 F.2d 504 (2d Cir. 1991))

Internet hoax viruses e.g. good-times „virus"

M. Ludwig, The Giant Black Book of Computer Viruses, 2nd ed 1998, pg 163, 261 and other publications

Net Crime and Melissa

March 26th 1999: Melissa posted to alt.sex.. by skyrocket@aol.com

March 29th: Melissa spread through the Net. Major companies close down E-Mail. Phar Lap analyses Melissa and finds GUID in Word-Document. FBI closes „SourceOfKaos.com" and „Codebreakers.org"

March 30th: FBI seizes Kaos-Webserver, Owner of skyrocket-account denies to be creator and sender of Melissa

April 1st: Court orders AOL to disclose any information about Melissa, New Jersey Police arrests David L. Smith with the help of AOL technicians

April 8th: First Court hearing against Smith

August 26th: Smith confesses

What do Viruses cost?

Total 1998 worldwide Anti-Virus Software Revenue: $ 1 Mio

Consequential Damages: ??

Potential Abuse of Viruses: Espionage, Forgery of Data, Documents, and Signatures, Shutdown of any kind of Computer Operated Apparatus, Military Applications

Which Actions concerning Viruses should be a crime?

Consequences

- Damaging
- Espionage
- Forgery of Data
- Fraud

Specific Actions

- Creation

Trading

Setting free

Setting free with Intent of Consequences

The Answer of (general) Criminal Computer Law

Hawaii criminal code § 708-892 unauthorized computer use and codes of most other US states

German Criminal Code § 303a „Datenveränderung" et al

Austrian Criminal Code § 126a „Datenbeschädigung" (StRÄG 1987)

The Answer of specific Criminal Law

18 USC Sec 1030 (1994)

Criminal (Penal) Codes of California (Sec 502 (c) 8), Illinois (720 ILCS 5/16D Insertion of Harmful Program), Minnesota (Sec 609.88 Distribution with Intent of Harm), New York, Texas

UK, Finland

Swiss Criminal Law Art 144bis

US Federal Law

18 USC Sec 1030 (a) (5) (A): „Whoever knowingly causes the transmission of a program, information, code, or command, and as a result of such conduct, intentionally causes damage without authorization, to a protected computer..." („Computer Fraud and Abuse Act"1984, amended in 1986 and 1994)

Californian Penal Code Sec 502

(c) Except ... any person who commits any of the following acts is guilty of a public offense:

...

(8) Knowingly introduces any computer contaminant into any computer, computer system, or computer network.

Swiss Criminal Code Art 144bis

1. Wer unbefugt elektronisch ... gespeicherte oder übermittelte Daten verändert, löscht oder unbrauchbar macht, wird, auf Antrag, ... bestraft.

2. Wer Programme, von denen er weiss oder annehmen muss, dass sie zu den in Ziffer 1 genannten Zwecken verwendet werden sollen, herstellt, einführt, in Verkehr bringt, anpreist, anbietet oder sonstwie zugänglich macht oder zu ihrer Herstellung Anleitung gibt, wird ... bestraft.

Comparison to other Threats: Poisons, Real Virus

Is development forbidden? - in most states no

How would you legally develop medical treatments without the poison or virus?

Is production forbidden? - in most states no, even not in case of drugs (depending on quanitity)

Is dissemination forbidden - yes, even without intent (e.g. Austria: § 169 StGB Fahrlässige Gemeingefährdung)

Problems of Criminal Investigation and Procedure

International Distribution

International Collaboration

Hearsay Evidence Rule

Who is obliged to help the authorities?

- Experts
- Suspect
- Witnesses
- Producers e.g. by including logging, tracing and GUID into their products

Prevention

Persuade authorities to build up adequate knowledge

Dissuade producers of internet-relevant systems to make virus programming easy (e.g. by procurement rules, advertising, ...)

Persuade providers to provide their services with adequate security

Persuade users to think over security (e.g. use edp-systems with access control, make boot sectors, template-files, etc readonly)

3D Inhabited Virtual Worlds
Interactivity and interaction between avatars, autonomous agents, and users

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Abstract: This paper addresses some of the central questions currently related to 3-dimensional Inhabited Virtual Worlds (3D-IVWs), their virtual interactions and communication. First, 3D-IVWs – seen as a new and unique form of multimedia – are introduced and the social construction of the 3D-IVW technology is briefly discussed. Second, a selection of the basic concepts and identifiable entities in 3D-IVWs is defined and commented upon. Third, some of the strange digital creatures, which currently inhabit 3D-IVWs in the form of cyber-hybrids, are outlined. Fourth, modes of interactivity and (virtual) interactions between users, avatars, bots, etc. in the new Virtual Worlds are briefly presented and typologized. Finally, the changing Internet and the virtual futures of 3D-IVWs are reflected on.

Three-Dimensional Inhabited Virtual Worlds (3D-IVWs) are currently becoming a reality. They first appeared in computer games and stand-alone multimedia applications, but are increasingly appearing in networked-based systems, e.g. the Internet, intranets, and the World Wide Web. Considered as new media, they can be characterized by the following traits:

- 3D-IVWs are generated from software, drawn as interactive computer graphics in 3 space dimensions (plus a 4^{th} dimension in time), i.e. they exist only in cyberspace: in the digital domain of the computers and the computer networks.
- 3D-IVWs are represented on a two dimensional screen, i.e., 3D graphics in this context are understood as a way of representing 3D data in 2D so that it can be viewed on a computer monitor or a TV screen.
- 3D-IVWs usually contain computer-generated representations of their users – *inter alia*, so that other users can see them – in the form of so-called 'avatars'. In other words, this software is inhabited – inhabited by its users, designers and developers.
- These avatars can be moved around as movable computer graphics on the 3D scene and the movement is controlled interactively by the user.
- An avatar has a viewpoint that is fixed relative to the avatar.
- Consequently, as the user moves the avatar around, its viewpoint also moves. Because the background is animated, as well as the objects in the scene, the user can see the whole scene move relative to the figure. In short, the user can interactively control the viewpoint relative to the 3D space or scene.

One might call these environments '3D Inhabited Virtual Worlds'. However, they have other names as well, such as '3D Cyberspace', 'distributed virtual reality', 'Shared Spaces' [Bradley et al. 96], '3D Internet' [Wilcox 98], '3D Web', '3D chat', 'inhabited digital spaces' [Damer 95], 'Avatar Cyberspace' [Damer et al. 98b], 'avatar virtual worlds' [Damer 98a] etc. These 3D worlds are currently enjoying rapid growth. Fully implemented, existing virtual worlds include: Active Worlds, WorldsAway, Biota's Nerve Garden, Blaxxun, Traveler, The Palace, Oz, Worlds Chat etc. – and even more 3D-IVWs are under construction at the moment. Some of these 3D-IVWs are (re)constructions of large 3 dimensional 'cities' with buildings, streets etc., others are marketplaces, stages, TV programs, space stations, still others are strange places that have no similarity, whatsoever, with anything in the non-virtual world [cf. Jensen 98, 99a]. The majority of these worlds are accessible from the WWW.

Thus, while the Internet has [cf. Jensen 96], until now, primarily been a set of sites, which could be visited, a pile of two-dimensional documents that could be surfed, it is slowly turning into a three dimensional space with a virtual volume – thereby, for the first time, giving the term 'space' in 'cyberspace' a literal meaning – i.e., an entirely digital environment that can be lived in and populated and in which the users can move around, communicate, and interact. In these Virtual Worlds, it is possible to meet and have (mediated) social interactions and communication with other users on the network in real time. Via these simulated interactions, a new type of virtual social practice and virtual social structure or culture is being created. In other words, the Internet is changing from a dead and flat library, to a social and communicative space: a web of human relationships – a community. And the users are transforming themselves as well from 'surfers' to 'settlers' [cf. Bradley et al. 96].

It is these 3D Inhabited Virtual Worlds and their virtual interactions and communication that are the primary objects of this study.

Hypotheses and Theory

The paper is based on the following hypotheses (all in accordance with semiotic theory and media studies):

- That interactive multimedia systems and, more specifically, 3D-IVWs, like other media, develop a set of signs, codes and conventions, i.e., they develop a formal language specific to that medium just as theater has developed a dramaturgy, film a film language, television a television language, etc.
- That through theoretical work and empirical analysis it is possible to identify and describe the formal language and functionalities of 3D-IVWs.

- And that knowledge of older media can be helpful in the process of identifying and analyzing the new language and new aesthetics of 3D-IVWs. Presenting themselves as 3D-IVWs with artifacts and actors (avatars, autonomous agents etc.) it is the assumption of the paper that this new medium can be informed by theater and film theory in particular [cf. Jensen 99b].

On the other hand, although interactive multimedia in general, and 3D-IVWs in particular, are informed by existing representational conventions from film and theater (such as the relationship between stage and actors in theater, or the function and representation of point-of-view and 3D-perspective in film), they also break with the traditional functional and aesthetic conventions of these art forms. The most obvious examples are the user's ability to control movement and point-of-view in the Virtual World, the users mutual interaction represented by avatars, or users and avatars interaction with autonomous agents. In these aspects there are clearly no immediate parallels in the worlds of film and theater or other traditional (mass) media. Consequently, we have to supplement the first three hypotheses with the following (all in accordance with sociology and interaction analysis):

- That the signs, codes and conventions of the 3D-IVWs create a framework for and influence the interactivity (user/system) and the virtual interaction (user/user, user/environment, etc.) within the 3D-IVWs.
- That through theoretical work and empirical analysis it is possible to identify and describe the interactivity and (virtual) interaction.
- And that knowledge of interaction in non-virtual settings can be helpful in analyzing interactivity and virtual interaction within 3D-IVWs.

In regard to theory and methodology, the paper draws from sociology, interaction analysis, interpersonal communication, semiotics, cultural studies, and media studies.

The Background and the Social Construction of the Technology

3D-IVWs have a complicated background and consist of the convergence of a number of very different media and areas. Sue Ki Wilcox points out no less than five fields, which are said to have inspired 3D graphics. The first fields are: computing, the Internet, science fiction and theater. Fields which are said to have contributed the following characteristics: "Computing supplies the power to make desktop virtual reality happen; the Internet provides the space and freedom in which to develop; science fiction introduces the idea of cyberspace; and theater teaches the concepts of actors and role-playing" [Wilcox 98]. A bit earlier she also involves the social aspect as an important element. "Currently, the social aspect of the World Wide Web is just beginning to emerge from the newsgroups and e-mail stage... and the more lifelike it becomes, the more people want to be involved. Avatars promise to be even more engaging..." [Wilcox 98].

Bruce Damer identifies – slightly more modestly – Virtual Worlds as the children of two humble parent technologies: 'text-based virtual community' and 'computer games' [Damer 98a, Damer et al. 98a]. The aforementioned contributed in the form of communities built up around text systems and simple text messaging such as conference systems like the WELL, MUDs, MOOs, UseNET, IRC, chat rooms in on-line services and on the WWW, as well as some early text-based virtual communities expanded with graphic interfaces, where users are represented by avatars (such as Habitat, mid1980s), which is said to have contributed the sense of community built up around common interests. Computer games primarily contributed realistic 3D graphics and effects, especially "the power of existing 3D rendering engines developed for gaming applications such as Doom and Quake" [Damer et al. 1998a], which demonstrated that 3D graphics and virtual worlds could be fast and effective using minimal computer hardware like a regular personal computer. In other contexts, Damer includes a third predecessor: "The whole infrastructure of Internet Protocol and the World Wide Web" [Damer 96].

In this context, 3D-IVWs will be considered as consisting of four basic elements or building blocks: Virtual Worlds, 3D-graphics, Artificial Life, and Virtual Communities:

- The term 'world' refers to the all-encompassing context for the totality of human activities and experiences and the term 'Virtual World' refers to "computer programs that implement digital worlds with their own 'physical' and 'biological' laws... VW is concerned with the simulation of worlds and the synthesis of digital universes" [cf. Heudin 98, cf. below].
- '3D-graphics' refers to a way of representing three-dimensional data or 3D graphical spaces in two dimensions so that it can be viewed on a screen or a computer monitor.
- 'ALife' or 'artificial life' refers to digital simulations of living systems, which incorporate metaphors from biology, i.e., biologically inspired, synthetic organisms.
- And 'Virtual Communities' refers to human social communities that form in and around digital virtual worlds, often in the form of a group of people communicating with each other through computer networks.

These four elements are brought together and integrated within 3D-IVWs, which are generally constituted around computer simulations of whole worlds or digital universes with artificial life forms and social communities. The following will expand upon this attempt to define and discuss some of the key concepts in relation to 3D-IVWs.

Virtual Worlds – basic concepts

Representation. The concept of representation refers to all aspects of the appearance of virtual worlds including the appearance of avatars, bots, objects and other elements of the virtual world. Representation is related to the concept of sign. A sign is "something which stands for something else to somebody" [cf. Peirce 31-58]. In other words, a sign is a manifest, perceivable entity (whether it is a thing, an element of behavior, a form of appearance, etc.) which is received by the sense organs of an interpretative, mental apparatus and is interpreted as referring to something else (an item, phenomenon, feeling, event in the real or virtual world, etc.). The interpretative, mental apparatus establishes a relationship or a 'link' between the entity, which represents and that, which is represented. The actual sign is then finally constituted as a relationship between these three entities: the representation, the entity that is represented, and the mental apparatus that interprets the first by linking it to the second [cf. Jensen 93]. In this way, signs can be seen as quite a distinctive class of phenomena, since they have meanings: they stand for or refer to other objects or events. The concepts of sign and representation naturally play a key role in this context of what are, in a certain sense, purely symbolic worlds; worlds which are exclusively constituted by representations, by signs. There are several types of representations or identifiable entities in 3D-IVWs, which will be considered and commented upon in the following.

Virtual World. The concept 'Virtual World' covers the total virtual environment, i.e., the whole 3-dimensional scene or 3D-space with its set of various objects and with all its special characteristics. The terms 'Virtual World', 'scene' and 'space' are here more or less synonymous. This 'virtual 3D space' has a number of general characteristics:

- It is coordinate-based, i.e., every position in the space can be identified by a set of 3 coordinates.
- It is geometrically finite, i.e., it makes up a 'bounded', 'delimited' world.
- It is continuously navigable, i.e., the user can move seamlessly through the world without transition of any kind. The space itself, however, can be made up of several linked files, as long as they appear to the user to be seamless.
- It is defined by a set of 'physical', 'biological', 'social', etc. rules. These rules have an affinity to physics-based laws like laws of nature, i.e. they define how one may move, interact, communicate, etc. in the space, except that in this case it is the designer, the creator of the world, who has established the rules.
- Each world represents a specific vision of what a virtual world can be and which experiences it can offer its inhabitants and users. Virtual worlds thus have their own ontology since all conceivable forms of existence seem to be possible within them, or more precisely: the nature of being is here only limited by the current technology and imagination.

In these virtual worlds or 3D-spaces there may be various types of interiors or elements, which can roughly be divided into objects and actors, differentiated by whether or not their primary function is to carry out an action.

Objects. An object can be defined as a limited, relatively autonomous part of the world. Examples of objects are trees, billboards, windows, doors, posters, etc. including props, i.e., the accessories or attributes of an avatar such as: a hat, a bike, a cane, etc. Objects typically consist of two basic components: 1) a model that determines what the object looks like, its size, etc. and 2) some characteristics that determine where it is placed, which actions it can carry out, etc. Objects can also be assigned actions, therefore, drawing a precise border between objects and actors, especially 'bots' (cf. below) can, in some cases, be difficult.

Actors. 3D-IVWs are not, however, solely composed of a space and objects; this space is also inhabited. Actors are entities that inhabit the virtual worlds and whose primary function is to carry out actions. They have two main forms, which will be described – for the moment– as relatively sharply differentiable polar opposites. This is done based on questions such as: who is controlling the actors? 'who is doing the driving'? On the one hand there are actors that react independently of the user, but which are controlled by software or AI, the so-called 'autonomous agents' or 'bots' (short for robots). On the other hand, there are agents, which directly represent and are controlled by users, the so-called 'avatars'.

Bots or autonomous agents. A bot or an autonomous agent is a bit of software, which is not directly or interactively controlled by a human user, but runs on its own, controlled either by a program or by some form of built in intelligence. In real life (RL), robots are often physically manifested as machines. On the Internet or the Web bots are often invisible or are only represented in a visible mode in the interface during input or output situations. The special thing about bots in 3D-IVWs is that they (most often) are represented as visible, that is, they have a sensory representation in the virtual world. In many cases, bots are similar to other users (i.e. avatars) and appear as a kind of automated or virtual avatar. Similarly, they may have some degree of built in AI, independence, self-motivation, personality, etc. Often bots are given specific assignments. In 3D-IVWs, they are usually used to inhabit sparsely populated spaces and thereby to provide the user or the avatar with company (automated conversational agents), to show the way or to guide tours, to answer questions, to entertain by asking riddles or offer clues to puzzles, to provide information on present users, the present scene, etc.

Avatars. At the pole directly opposite the bot or the autonomous agent is the avatar. Even though avatar technology is relatively new, the term 'avatar' is paradoxically quite old. It comes from Sanskrit and means something like 'the embodiment of a spirit in the flesh'. In its modern, digital, virtual incarnation an 'avatar' is defined in many different ways. Wilcox defines an avatar as "an electronic representation of a person in cyberspace", "[a] virtual expression of yourself, wearing your wardrobe of virtual clothes" or "an electronic version of the human form designed to let you enter cyberspace" [Wilcox 98]. And Damer defines it as "a digital body you can see", "a virtual personality in a 3-dimensional world" [Damer 98a] or "animated 3D models of users" [Damer et al. 98b]. An avatar is, in other words, a representation of the human actor or user in the virtual universe which can be manipulated and controlled by the user in real time, even if the representation is, at the same time, bound by the limitation and laws of the virtual world in question. In this particular sense, avatars are – as Wilcox also formulates it – "extensions of ourselves". So if Marshall McLuhan's old catch-phrase "media and technology are extensions of ourselves" has ever been relevant it must be now, in relation to 3D-IVWs, where the slogan has been given a most concrete incarnation in avatar technology.

The avatar serves several functions. It is necessary in order for the user to be visible to others and thereby to have a 'presence' in and interact with others in the virtual world. It is necessary for the user to have a position in the form of a set of 3 coordinates and thereby a viewpoint and a sense of 'presence' in the 3-dimensional world. And it is generally necessary in order for the user to enter, move around in and experience the virtual space as well as to become a member of the virtual community. In 3D-IVWs then, avatars are used (virtually) to meet new people, have new experiences, visit new places, learn, play, etc.

An avatar has two important aspects: appearance and functionality. One important thing about an avatar is naturally its appearance, what it looks like, because it is synonymous with the way the user presents himself in cyberspace. Another important thing is functionality, since an avatar can have many different functions. It can be equipped with animation, behavior patterns (where 'behavior' here refers to a sequence of animations), it can show emotion via facial expression, carry objects, belongings or props or be able to prove identity in connection with financial transactions and, if desired, also give gifts and have pets. As far as special behavior patterns go, the components of animations and behavior – like avatars themselves – are often selected from galleries and then personalized. Specific animations and behaviors can then be released or triggered by different factors such as: user behavior (a click of the mouse and the like), a time factor, collision detection, proximity to other objects or avatars, the appearance of an object, a touch sensor, etc. Although by definition avatars are under the control of the user, the degree of control can vary in practice quite a bit. In certain cases the user can completely control all of the avatar's movements and communicative actions down to the smallest detail. In other cases, the user can only determine actions, behavior patterns, gestures, moods, manipulation of objects, etc. on a more general level. This behavior is then carried out by a pre-programmed automatic system. In yet other cases, parts of the avatar's behavior can be controlled by the user, while other parts are controlled by a system or a more or less intelligent program.

Within the avatar category there are both *user-in-avatar*, which is a representation of the human user in the 3D Virtual World and *designer-in-avatar*, which is a representation of the designer, developer or creator of the 3D world (sometimes called 'God'). 3D Virtual Worlds are then the only type of software, where one can actually meet and speak with the author of the application – within the application itself.

Human Actor. Finally, there is the human actor or user of the 3D system or world, who actually controls the avatar and/or the viewpoint of the world.

Cyber-Hybrids

Although there is then, in principle, a differentiation, in terms of definition, between bots and avatars, both concepts cover a relatively wide spectrum of very different types of phenomena with differing degrees of control. There also seems to be a tendency toward the appearance of more and more hybrids – we could call them 'cyber-hybrids' – combining avatars and bots. Furthermore, these hybrid forms are in many ways the most interesting and most promising in the virtual worlds at the moment. Rather than considering avatars and bots as polar opposites, it may therefore be more productive to consider them as the outer points along a continuum, between which can be found all sorts of combinations or hybrids. The following will briefly outline a typology of these strange new hybrid creatures, which currently populate this continuum in the virtual worlds [cf. Wilcox 98].

Alife/Digital Biota. Along the continuum between autonomous agents and avatars, Alife (Artificial Life) or digital biota is closely related to the former. Alife and digital biota are artificial or 'alien' life forms, i.e., biologically inspired, synthetic organisms in the form of quasi-autonomous software. Thus, Alife is the virtual world's counterpart to the real world's plants and primitive animal life forms. Jean-Claude Heudin describes the vision of ALife in Virtual Worlds in the following way: "Imagine a virtual world with digital creatures that looks like real life, sounds like real life, and even feel like real life ... This virtual world could be familiar, reproducing some parts of our reality, or unfamiliar, with strange 'physical' laws and artificial life forms" [Heudin 98]. Alife as a general area of research deals with artificial living systems and the general principles of the living state. *Alife online* describes the field and its background context in the following way: "Artificial Life – literally 'life made by Man rather than by Nature'. Artificial Life ('AL' or 'Alife') is the name given to a new discipline that studies 'natural' life by attempting to recreate biological phenomena from scratch within computers and other 'artificial media'... By extending the horizons of empirical research in biology beyond the territory currently circumscribed by life-as-we-know-it, the study of Artificial Life gives us access to the domain of life-as-it-could-be... " [Alife online 98]. With regard to the definition of 'digital biota' and their boundary surfaces to creatures such as bots, agents, AI, etc., Biota.org writes: "Digital Biota are a class of self-replicating autonomous software objects which includes computer viruses, artificial life programs, some cellular automata and some genetic algorithms. Once released they live or die by their own decisions as they interact with their environment. They are usually capable of reproduction – if they also have the ability to mutate and be affected by the force of natural selection to some degree then they can evolve. Biota shade out into the region of semi-autonomous objects which includes artificial intelligence, software agents and bots. These generally have only limited control of their own functionality, operate according to outside goals, and do not reproduce... The increase in avatar inhabited virtual environments on the Internet is one potential breeding ground for such digital biota" [Wilcox 99]. As can be seen here, there is not only a continuum between agents and avatars, the continuum stretches across the whole field of actors and objects: from avatars, to biota and Alife, to agents, AI, bots and (semiautonomous) objects.

The best know examples of Alife and digital Biota are probably: Tom Ray's Tierra, a digital ecosystem that produces synthetic organisms based on a computer metaphor for organic life; Karl Sim's 3D virtual creatures; and Biota's Nerve Garden, a biologically-inspired multi-user collaborative 3D virtual garden hosted on the Internet – i.e., a public terrarium in cyberspace – where visitors can plant a seed and watch it grow.

Characters using genetic algorithms. A bit closer to humans on the continuum between the artificial and the human are characters, which use genetic algorithms. In other words, these characters have a built-in ability to learn from the interactions they participate in, to learn from experience, and thus continuously change their characteristics and functionality. They often have a relatively independent existence in the given virtual world where they can live out their own life. Among the best known examples are perhaps CyberLife's popular game *Creatures*, where the user is supposed to raise the creatures from the egg stage, and the Japanese Tomogatchi.

Game Characters. In the middle of the continuum, but perhaps closest to the autonomous agents, are Game Characters. They are, as the name indicates, often related to games and can be regular autonomous agents with an independent existence and functionality in the universe of the game. At any given time, however, a user can take over control of a game character – for example as a tool for getting into a game, in order to learn the rules of a game or under particularly exciting and critical passages in the action – in which case the Game Character's status is temporarily transformed into an avatar.

Mask Characters. Closer to avatars are Mask Characters. Mask Characters are avatars which – aside from the usual physical form and functionality of an avatar – also have a character that can control, guide or inspire the user, who is using it. F. ex., the character can tell the user, which high-level directions make sense in a given situation, and then given the user's choice, improvise a course of behavior [cf. Hayes-Roth et al. 97]. In other words, it is a 'smart' avatar with an independent mental life, a consciousness or a will. As such, Mask Characters are used in ecommerce, learning, and entertainment as well as to teach users to play certain roles in the virtual environment. Examples are Hayes-Roth's and Extempo's 'Imp Characters' which are guided by their roles, their personalities, their moods, as well as real-time directions form the user or other software.

Virtual Humans. Virtual Humans are 'naturalistic' copies or stand-ins for humans, where the main principle is to create the most convincing, realistic or perfect simulation of the human form and function (while normal avatars and agents may look like just about anything). Emphasis can be placed either on form (appearance) or functionality or both at once. Virtual humans are used primarily in simulations and in the testing of products and environments, but also in games and movies. Along the continuum between autonomous agents and avatars they, in reality, cover the whole stretch. In the bot-incarnation they may appear as pure dummies which make up simple pre-programmed, animated figures in a 3D model or they may be autonomous agents, which are controlled to some degree by artificial intelligence. In the avatar-incarnation they may be directly and interactively controlled by a human actor, e.g. in the form of 'ergonomic avatars' in connection with virtual trials of products, processes or environments by way of simulations in cases where Real Life trials may be inexpedient. The same virtual human can in fact change between being a bot and an avatar. The most prominent examples in this category are perhaps the computer-generated – but very realistic – Japanese pop star and personality Kyoko Date, made up of 40,000 polygons, and the work done on realistic avatars and virtual humans at MIRALab, Geneva.

Avatar/Agent. Furthermore, there are more and more examples of actors in virtual worlds being able to instantly switch, so to speak, from the avatar-mode to the bot-mode. One example is 3D Planets 3D-assistant, a 3D representation that can both function as an agent controlled by a program and be used as an avatar, depending on the situation encountered and the programs being run. The assistant functions in principle as an interface between the program that is actually running and the user, sometimes controlled by the program and sometimes controlled by the user. In this way, the 3D-assistant perhaps gives us a taste of what a so-called 'assistant interface' might look like in the future. Or one might imagine a user who participates in a communicative community represented by an avatar, but whose avatar lives on – even *after* the user has left the world and the computer – switched to some kind of 'automatic pilot', continuing to interact and communicate with other agents and avatars (perhaps also running in an automatic mode). In this mode the automatic avatar might either follow pre-determined parameters or pre-programmed behaviors, follow some form of artificial intelligence, or even simulate or mimic what it has learned from the particular user.

Interactivity, Interaction & Virtual Interaction

An area of particular interest in connection with 3D-IVWs obviously involves the new possibilities for interaction and interactivity that arise, partly seen in relation to RL-interaction, and partly in relation to interaction and interactivity [cf. Jensen 97] in more conventional media and computer applications.

Interaction. In sociology the word 'interaction' refers to the actions of two or more individuals which can be observed to be mutually interdependent, i.e., interaction can be said to occur when each of at least two participants is aware of the presence of the another and each has reason to believe the other is similarly aware, in this way establishing a state of reciprocal awareness. In other words, interaction is the relationship between two or more individuals who, in a given situation, mutually adapt their behavior and actions to each other. Important aspects here are that limited, clear-cut social systems and specific situations are involved, where the partners in the interaction are located in the same time and space – i.e., are in close physical proximity – and 'symbolic interaction' is also involved, that is, a mutual exchange and negotiation regarding meaning takes place between partners who find themselves in the same social context. A phenomenon which communication and media studies would call communication, or more precisely – since the partners in the interaction are situated in the same context – face-to-face communication or interpersonal communication.

Virtual interaction. In relation to this general definition, *virtual interaction* takes on a number of special traits. Once again interaction is connected to a concrete situation and a limited and clear-cut (though here virtual) social system and once again we can speak of symbolic interaction between the participating partners. However, the special thing about interaction in virtual worlds is that the interacting partners are situated in the same time (in terms of real time systems), but not within the same space. On the contrary, the interacting partners – understood as the human actors – are physically distributed without any immediate physical proximity, i.e., the interaction itself is mediated and only the interactors representations share this physical proximity. The concept of 'virtual interaction' refers, in this context, to the relationship between virtual representatives of human actors situated in the same time and virtual space – i.e., in a form of virtual proximity – within a limited (virtual) social system; virtual representatives who mutually adapt their behavior and actions to each other and which mutually exchange and negotiate meaning and create a 'symbolic interaction'. Consequently, there is no face-to-face communication. On the contrary, there is a new form of face-to-interface or interface-to-interface communication. Only the avatars practice (virtual) face-to-face communication. One of the unique traits of virtual worlds as a medium is then, that they allow for the possibility of practicing face-to-face communication with all that that implies with regard to facial expression, gestures, body language, etc. – in a mediated and virtual form. Thus, in Inhabited Virtual Worlds, interpersonal communication and the knowledge that this discipline represents becomes, for the first time, relevant to the computer world. Moreover, since there is a sliding scale from representations of human users – avatars – to bots, animated objects, etc., the concept of virtual interaction also covers the mutual relationship between avatars, bots, objects and other elements within the virtual world.

There are several different types of virtual interactions and simulated communication of interest in 3D-IVWs. If, to begin with, for the sake of clarity, we disregard the entire population of cyber-hybrids and only examine avatars and autonomous agents as relatively pure forms, these virtual interactions can be represented by the following matrix [cf. Fig. 1] where the redundant combinations have been eliminated.

	Actor (human)	Designer-in-Avatar	User-in-Avatar	Bot	Object	Virtual World
Actor (human)	Ac / Ac					
Designer-in-Avatar	D-in-A / Ac	D-in-A/D-in-A				
User-in-Avatar	U-in-A / Ac	U-in-A/D-in-A	U-in-A/U-in-A			
Bot	Bot / Ac	Bot / D-in-A	Bot / U-in-A	Bot / Bot		
Object	Ob / Ac	Ob / D-in-A	Ob / U-in-A	Ob / Bot	Ob / Ob	
Virtual World	VW / Ac	VW / D-in-A	VW / U-in-A	VW / Bot	VW / Ob	VW / VW

Figure 1: Matrix of types of interactions in 3D-IVWs

Due to limited space, only some of these types of virtual interactions will be described and discussed below.

Human Actor/Avatar. Interaction between a human actor and an avatar consists of the user controlling the avatar and communicating and interacting through the avatar. This depends, among other things, on how the avatar is controlled: via keyboard, mouse, joystick or some form of motion capture. Thus, this area corresponds to a certain degree, to the traditional area of Human Computer Interaction, or what is called interactivity [cf. Jensen 97] in conventional computer systems. The interaction is, however, mutual since the user must also adapt to the avatar's specific movements (e.g. its degrees of freedom) and abilities, its repertoire of expressions, as well as its built-in limitations. It is, for example, quite important whether the given avatar can express itself in written language, only in spoken language, or only through body language and facial expressions. The relationship between human actors and avatars also touches on the pivotal question of identity. A question, which in virtual worlds, more than being a philosophical or existential issue is primarily a question of relationships between an avatar and a person in RL. The question of identity concerns e.g. whether a person in RL can have several alternative virtual identities, the question of techniques for validating identity, visual appearance as a key to identity, etc. Identity in virtual worlds, then, concerns how it can be verified, stored, communicated, transmitted, etc.

Human actor/Object. Controlling an avatar is one thing, manipulating an object in a virtual world is quite another. How does one f. ex. throw a ball or catch something? This form of interaction deals with how one interacts with a virtual object-world via the computer's traditional input-output devices, but it also deals with how users implement objects in real time.

User-in-Avatar/User-in-avatar. Mutual interaction between avatars is perhaps the most interesting part of interaction forms in Virtual Worlds. It deals with how avatars communicate or exchange information between each other – through written text, voice, gestures, facial expressions, etc. – and how they exchange objects including HTML documents, business cards, props or other 3D objects. However, it also deals with how changes in the position of the avatars, movements and communication are tracked and how these changes are communicated to the rest of the surrounding world. Likewise, it deals with how avatars document their identity in relation to one another, f. ex. in connection with financial transactions.

User-in-Avatar/World. Interaction between a user-in-avatar and world primarily concerns the physical, biological and social 'rules' that are established for the world in question and the possibilities and limitations they set for the ways in which the avatar can navigate, maneuver through space, communicate, interact, etc. within that world. It also, however, concerns the 'rights', i.e., the range of permitted actions, that the avatar have within that world: the right to chat on certain channels, the right to enter but not to change the world, the right to make changes in the world and to what extent. For example: is the avatar allowed to move objects? leave graffiti tags on the walls? carry out vandalism? and will these changes endure when the avatar leaves the world? But avatar vs. world interaction also concerns which types of avatars the given world permits. Is it possible, f. ex., for the user to bring along his own tailor-made avatar designed independently and therefore new to the world? how complex is this avatar allowed to be in terms of polygons, considering the amount of calculation time that is needed for its representation? alternatively, are only avatars designed especially for the world in question permitted or is there a specific avatar file format? It also concerns how avatars arrive in the world (is there a pre-determined arrival spot?) and which objects can be brought into the world (does the world accept avatar props such as hats, bikes, dogs, etc. or is it necessary to leave them outside the world?). This type of interaction is not just about what avatars can do in relation to the world, but also about what the surroundings can do in relation to the avatar, e.g. what does the world look like from the avatar's position? does the world address – e.g. speak directly to – the user-in-avatar (or human actor)?

User-in-avatar/Bot. Interaction between user-in-avatar and bots concerns what bots are programmed to do and whether there are characteristics of avatar behavior that trigger agent actions and vice versa: collision detection, proximity, visibility, touch, etc. It also concerns whether agents are equipped with some form of artificial intelligence, originality, or self-motivation. Bots are often used in 3D-IVWs to carry out standard functions such as greeting avatars to the new world, giving guided tours or simulating interaction and communication with real avatars when no others are present.

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User-in-avatar/Object. Similarly, interaction between user-in-avatar and objects typically consists of avatars being affected by the object (f.ex. stopped by it) or in some way being able to handle it (pick it up, carry it, move it). Or conversely, that an object reacts to the proximity of an avatar (becomes visible, rotates, blinks, makes a sound, etc.). Also in this case various types of triggers for action such as collision detection, closeness, visibility, touch etc. play an important role.

Virtual World/Bot. The relationship between Virtual Worlds and bots concerns things like which bots the given world allows, and which rights they are given from the world creator. This type of interaction may deal with protecting the world from being changed or destroyed by invading bots. Examples: can a virtual dog dig a hole in a lawn? can virtual weeds in the form of biota spread throughout a garden? can virtual termites chew holes in the furniture?

Virtual World/Object. The relationship between Virtual World and objects deals with which types of objects the virtual world accepts and which actions can be connected to those objects. It also concerns whether or not objects are persistent. This last instance can allow a user to place an object in a virtual world, to give a virtual gift, etc., which remains in the world even after the user/avatar has left it.

Virtual World/Virtual World. Finally, interaction or relationships between Virtual Worlds concerns whether or not it is possible to jump from one virtual world to another, as well as *how* these jumps can be carried out. In other words, it concerns the technical specifications for the various network-connected worlds. From the most general perspective it therefore also deals with whether development is moving toward universal cyberspace, where virtual worlds are compatible and interconnected, or whether there will be a multitude of incompatible, isolated islands of virtual worlds. The World-to-World relationship can also concern more specific problems regarding world's relationships to each other. What happens f.ex. if an object is thrown over the border of a world? Could it turn up in a nearby world, which may run on another server? Could it cause damage in the new world when it lands? And could it be retrieved from that world beyond?

The Virtual Futures of 3D-IVWs

3D-IVWs are not just being met with pure positivity and great expectations. There are also researchers who criticize the whole idea of 3D interfaces. "2D is better than 3D" was, for example the headline on Jakob Nielsen's Alertbox about a year ago "...because people are not frogs", he explained [Nielsen 98]. And he continued: "If we *had* been frogs with eyes sitting on the sides of the head, the story might have been different, but humans have their *eyes smack in the front of their face*, looking straight out". In arguing that 2D is more natural and intuitive than 3D, Nielsen digs up one of the world's oldest arguments – the evolutionary or perceptual aspect: "Evolution optimized *homo sapiens* for wandering the savannah – moving around a plane – and not swinging through the trees ... 2D navigation (on the ground) vs. 3D navigation (in the air)". A strange argument in itself, especially when Nielsen continues: "I do maintain that we are more capable of moving around a flat surface and that we spend most of our time doing just that". Strange, because moving around the surface of the earth is not moving in 2D since we do not find ourselves *in* the plane or surface of the earth, but *on* it. Contrary to Nielsen, it could be claimed that the fact that our eyes are placed in the front of our heads and that we are equipped with stereoscopic vision means that we have the ability to estimate distance and to see in depth, i.e. to see in 3 dimensions. Even 2-dimensional realities such as paintings, photography, film, etc. have developed a whole series of techniques to construct or fake a 3D effect [cf. Jensen 99], and correspondingly human perception has a built-in ability, as well as a tendency, to read 3-dimensionality into such 2D-representations. 3 dimensionality, depth, and perspective are as such extremely important for everyday perception and ordinary orientation. And, at this point, there is no reason to believe that the computer as a medium will not take advantage of this perceptional bias as well.

On the other hand, there is a long *de facto* list of important critical notes about the use of 3D on computers, some of which Nielsen correctly points out. Notes, which all primarily refer to today's state-of-the-art computer technology: devices such as the screen and the mouse, and current interaction techniques such as scroll, drag, drop etc., are all intended and designed for 2D interaction, not interaction in 3D. Navigation in a 3D space is often so confusing and difficult that users get lost. The 3D aspect means, among other things, that the user must also think about the 'behind' factor, i.e. what is behind him, are distant objects hidden by closer objects, smaller objects hidden by larger ones etc.? Besides, since the user must exert extra energy and attention in order to control and navigate the 3D view there is often a tendency to produce 'navigational overhead'. Poor screen resolution makes distant objects unrecognizable and text placed in the background illegible, and so on.

Some of these problems will, in time, be solved, some of them will not. So, many of the critical notes will still be pertinent within the foreseeable future. Consequently, there is no reason to believe, as it has been prophesied, that the 3D interface built around the metaphor of a space will, during the next few years thoroughly replace the current 2D interface based on the classic windows and icons desktop metaphors. 3D Virtual Worlds will most likely establish themselves as a medium or a type of interface among other media and interfaces. Certain applications and domains will be suitable for 3D and implemented as 3D Worlds, other applications and domains will not be suitable for 3D and thus be implemented, f. ex., as some sort of 2D media.

In many ways, Virtual Worlds are still a medium in search of an application. However, in the foreseeable future, the most important and dominant applications of 3D-Virtual Worlds will probably be a new galaxy of entertainment spaces offering action, (multi-player) games, adventures and exotic experiences; inhabited TV where viewers transmute into users and participants – in quiz shows, games and issue forums; virtual spaces for communication and interaction from family rooms to international political discussions; collaborative, community building environments; collaborative workspaces (GroupWare); shopping and transaction spaces; virtual class-rooms where students can learn together and from each other (at a distance); virtual meetings and events (virtual conferences, cyber-tradeshows, virtual exhibitions etc.); visualization spaces for physical objects that need to be understood in their solid forms (architectural sketches, design, molecular form etc.) and the like. And, just as likely, cyber-hybrids, combining avatars and agents will be used as: advanced visible message machines always available for access in a virtual world; stand-in communicators, taking some of the information load off the user; multidimensional tools to collect data, negotiate, and act as guides in virtual environments, etc.

Conclusion

The most interesting aspects of any given new medium are always its unique characteristics, the characteristics that differentiate it from all the other known media. To summarize, the unique and essential qualities of 3D-IVWs in relation to existing media are primarily.

- The medium makes it possible to move your personal representation interactively and thereby to (interactively) control your represented viewpoint in the 3D Virtual World.
- The medium makes it possible to interact and communicate with other users via representation and hereby also to interact and communicate visually and bodily with sign systems such as (virtual) body language, non-verbal signs, facial expressions, etc. For the first time in the history of the computer, the whole range of interpersonal communication, face-to-face communication, non-verbal communication, etc. is therefore relevant and of interest to computer science.
- The media both makes it possible to communicate in a (very flexible) context and to personalize communication and interaction.
- And the encounter with the computer is transformed from an experience of a two-dimensional interface, which can be clicked on, to the experience of a space in which the user feels a presence and a community with other people; and correspondingly, that the encounter with the Internet tends to change from an experience of a web of linked 2D-documents, to an experience of a galaxy of interconnected 3-dimensional Virtual Worlds. A true cyber-space where – as Pavel Curtis once put it – "people are the killer app".

References

Alive online (1998). *Introduction to Artificial Life*, http://alife.santafe.edu/alife/alife-def.html

Andersen P. B, B. Holmqvist & Jens F. Jensen (1993). *The Computer as Medium*. Cambridge University Press.

Bradley et al. (1996). Shared Spaces, http://vb.labs.bt.com/msss/IBTE_SS/

Damer et al. (1995). *Inhabited Digital Spaces*, http://www.ccon.org.papers/chidemcc.html

Damer, B. (1996). Inhabited Virtual Worlds. ACM Interactions, http://www.digitalspace.com/papers/index.html

Damer, B. (1998a). *Avatars!* Berkeley: Peachpit Press.

Damer, B. (1998b). *Inhabited Virtual Worlds*, http://www.digitalspace.com/papers/index.html

Damar et al. (1998a). *Inhabited Virtual Worlds in Cyberspace*, http://www.digitalspace.com/papers/index.html

Damer et al. (1998b). *Virtual Organizations and Virtual Worlds*, http://www.ccon.org/papers/twltpaper.html

Hayes-Roth, B. (1997) Story-Making with Improvisational Puppets. *ACM*, 2.

Heudin, J.-C. (1998). Preface. Heudin (ed.). *Synthetic Worlds and Artificial Life*. Addison Wesley Longman.

Jensen, Jens F. (1993). Computer Culture, in Andersen, Holmqvist & Jensen. *The Computer as Medium*. Cambridge: Cambridge University Press.

Jensen, Jens F. (1996). Mapping the Web. *Proceedings of WebNet 96*, AACE, Charlottesville.

Jensen, Jens F. (1997). 'Interactivity' – tracking a new concept. *Proceedings of WebNet 97*, AACE, Charlottesville.

Jensen, Jens F. (1998). Interaction and Representation in 3D-Virtual Worlds. *Proceedings of WebNet 98*, AACE.

Jensen, Jens F. (1999a). From 'Flatland' to 'Spaceland'. Spatial Representation, Enunciation and Interaction in 3D-Virtual Worlds. *WebNet Journal. Internet Technologies, Applications & Issues*, Vol. 1, no. 1, Jan.-March 1999.

Jensen, Jens F. (1999b). Film Meets 3D Internet, full paper to WebNet 99, in this volume.

Nielsen, J (1998). 2D is Better Than 3D. Jakob Nielsen's Alertbox, Nov. 15, 98, http://useit.com/alertbox/981115.html

Peirce, C.S. (1931-58). *Collected Papers*. Cambridge, Mass., Harvard University Press.

Wilcox, Sue Ki (1998). *Guide to 3D Avatars*. New York: Wiley Computer Publishing.

Wilcox, Sue Ki (1999). *Biota.org. A new expression of life*, http://www.biota.org/org/vision.html

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Non-Topical Factors in Information Access

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Abstract: Research in information retrieval has traditionally concentrated on making assumptions about the content of documents based on very shallow semantic analysis through word occurrence statistics of various kinds.

But texts are more than bags of words, and the semantic analysis information retrieval systems typically used is overly simple. There is ample reason to try to broaden the view of what text is and why.

Better content analysis alone will not be enough. Texts are more than their meaning. Texts have structure, they have context, they are written in a style conformant or discordant to a genre they are to be understood in, they may be carefully written or hastily thrown together, they are written by various types of agent for various reasons. Besides information to be found in the text or from the author, texts are used by readers of various backgrounds, for various reasons, and with varying degree of satisfaction.

This paper outlines a framework within which to find more knowledge from texts than an approximation of their topic, and gives examples of how to use this knowledge to design useful tools for information access.

What is in a Document?

Arguably, the most important characteristic of a document is what it is about. The topic of a document is the most important criterion for selecting it from a collection. How to model the topic of documents in a collection effectively is the most obvious goal for most research in information retrieval.

But researchers in the field are keenly aware of the fact that the interaction of information seeking users and the tools to access information sources is important in itself. Information can be sought for various reasons and with various ideas of how to determine what documents or other information bearing units are relevant. Indeed, no interactive information access system can disregard the requirements posed by users -- and this is most often understood to allow users to request documents from the collection with a minimum of complexity, by modeling document and query topic concisely and succintly, and to have systems respond rapidly with their inner workings transparent and understandable.

More Than Topic

Given that documents, besides topic, have internal structure, textual style, and usage context - not independently of topic, but highly dependent on it - the question is if this sort of fairly vague and informal variation can be used for information access purposes.

Most systems today put considerable effort in neutralizing and hiding this sort of spurious variation from the user.

But this information could be retained, just as easily. Modeling document variation along any number of vague dimensions can be done through none too complex analysis.

This is a first step towards new knowledge sources: less focussed than the obvious ones but knowledge sources just the same, and important situational factors in manual text categorization.

Text Usage: Collaborative Search

One of the most obvious characteristics of a document, besides its content, is its usage: documents have *context*, or *ecology*: texts are actually used by people for whom they are important [Walker, 1981].

The knowledge that documents are used differently and for different purposes can be used for better design of interfaces, to support various different access strategies [e.g. Belkin, 1994] - or by explicitly categorizing documents by the company they keep, by the other documents retrieved together with it [e.g. Karlgren, 1990; Resnick *et al* 1994; Hill, Maes]. The latter type of information can be used directly in retrieval. By gathering information about document usage or by asking users to list documents they appreciate a system will be able to *recommend* other similar documents - irrespective of topic.

This sort of systematic study of text usage rests on two observations. Firstly, users often have a fair idea of what they have read, and they can relate their query to their own readership history; the situation and the request in information retrieval situations can often be formulated as a form of "I read *A Good Book* - I want more of the same" posed to a librarian or a colleague, or to a number of them.

Secondly, an ordinarily unorganized bookcase may self-organize – somewhat unsystematically - based on users' behavior. Interesting documents may be found next to each other. They are interesting because someone placed or left them there, and they are placed there because they have some relation to the original document. In fact, in a library or a bookstore, people around an interesting bookcase tend to be interesting people. You tend to be able to get good reading tips from them. Similarly, a good librarian will remember that a certain book tends to be read by a certain set of people, and another book by the same set of people, and that there may be a similarity between the books, even though they may not be catalogized together - as of course, they often will not be. Anyone who has tried to organize a bookcase by topic knows how many cases of unexpected category conflict one encounters.

Text Style, Text Genre, and Text Structure

To a text reader, an obvious important dimension of textual variation is that of *style*. Stylistic variation between texts of the same topic is often at least as noticeable as the topical variation between texts of different topic but same genre or variety; style is, broadly defined, the difference between two ways of saying the same thing.

Stylistic variation in a given text, given the liberal definition above, can occur in many ways and on many linguistic levels: lexical choice, choice of syntactic structures, choice of cohesion markers on a textual level, and so forth.

Some choices are constrained by the intended audience and discourse ecology the text is produced in; some are left to be entirely determined by the author's preferences, personal idiosyncracies, and other qualitative factors of writing and editing. The former form the basis for distinguishing *genres* or *functional styles* that can be found in texts: newspapers, legal text, fictional prose, poetry; the latter, variation based on *individual style* [e.g. Vachek, 1975]. Stylistic variation is not orthogonal to or independent of variation that relates directly to content and topic, but is mainly along other dimensions. Naturally, there is covariance. Texts about certain topics may only occur in certain genres, and texts in certain genres may only treat certain topics; most topics do, however, occur in several genres.

Stylistic variation is easy to detect using surface cues in the text. Douglas Biber, for instance, has investigated what general dimensions of variation can be found in texts, and found that texts, across languages, speech and text, and genres can all be understood to vary along a small number of dimensions [1988, 1989, 1995].

Further experiments with simple stylistic cues, such as can be computed using readily available linguistic analysis tools show positive results. Even simple measures of terminological complexity - e.g. word length, relative frequency of long words, type/token ratios, relative frequency of various indicative lexical items - paired with measures of syntactic complexity - e.g. clause length, number of complex conjunctions give enough purchase to allow the analysis and recognition of text genres through their individual characteristics with relative ease [Karlgren and Cutting, 1994].

The measures were based on approximations of syntactic complexity – a dimension which exhibits considerable variation between genres [Losee, 1996; Menshikov, 1962]. Indeed, most stylistic measures heretofore have been attempts to find shortcuts for measuring syntactic complexity along with lexical complexity as measured by word lengths and occurrence frequencies of various sorts.

Besides the microstructure of text and its lexical items, *text structure* in itself is an important cue for manual categorization of texts. The subtopic structure of texts can be identified without too much complex computational machinery [e.g. Hearst and Plaunt, 1993; Hearst, 1997; Salton and Allan, 1994], by measuring the appearance and gradual disappearance of content bearing words throughout the length of the text.

In summary, text has easily distinguishable *form* in addition to *content* and *context*.

How can we use knowledge of document variation?

The types of variation mentioned above can be applied to the design and implementation of information access systems in several ways. Judgments or measures of documents based on new information could be added to today's relevance-based systems; alternatively the information can be used to categorize documents for presentation to the user.

Improving the Concept of Relevance

Information retrieval typically present results as ranked lists of documents, sorted after so-called system-determined of likely *relevance* to a search query. Given that we know more of documents today, adding this knowledge to a typical bare-bones retrieval system is not a trivial design task. If we know of a document that it may be of an interesting topic, it is a newspaper item, its style of writing seems to be personal and subjective, and that its quality seems to be rather low – how will we be able to convert all this information into a single dimensional ranking?

In fact, experiments have shown that stylistic and structural analysis can be implemented as filters for relevance judgments [Karlgren, 1996; Strzalkowski *et al* 1996]. Depending on the collection at hand, certain types of document often can be discarded from retrieved sets - in a web context, very short documents containg the words "can not be found" usually are less useful than others. This form of information can be encoded in some way to be combined with probabilistic ranking retrieval systems.

Many or most knowledge based systems combine information from different sources by *weighting*, typically combining them in a linear combination of scores. But there is no reason to assume that variables engage in a relationship of a type that is suitable for linear combination. Some might be binary: "If singular first person pronouns are present, a text is not a legal text." or the relationship may be more complex: "If there are numerous tense shifts and a relatively high incidence of personal pronouns the text may be an interview," which could contrast with "If there are plenty of pronouns in the text it may be fiction". Better ways of combining evidence, through decision trees or preferably a combination of decision trees, general pattern matching techniques, and algebraic techniques are absolutely necessary to be able to make use of and understand linguistic data.

And in any case, ranked lists give users little help in understanding and utilizing document variation: a richer representation of retrieval results to match a richer understanding of documents on the part of the system is a more fruitful approach.

Presenting Vague Categories

If we want to present users with information on e.g. document style or genre, we must (i) identify suitable categories or dimensions such as genres, (ii) choose criteria to cluster texts of the same category with usefully predictable results, and (iii) make use of these categories in an information access situation.

In the case of stylistic variation, useful genres must be based on differences known and recognized by readers. These differences mean different things to users, and may be difficult to recognize automatically. Naming them must be done judiciously to create and present a palette of genres both reasonably consistent with what users expect and conveniently computable using the measures of stylistic variation available to us [Dewe *et al.*, 1998]. (At this point we need to understand that *vagueness* is a desirable property in human language. If we want to present the user with categories based on notions of "quality" or "subjectivity" we are better off using abstract suitably vague terms to describe the document sets such as "Commercial text" and "Personal text" rather than try force decisions based on very concrete and well-defined terminology.) As but one example of such presentations, our prototype system combines stylistic analysis with topical clustering to broaden the ranking of a probabilistic background system into a matrix presentation of topical cluster by genre [Bretan *et al.*, 1998].

Style, Relevance, and Quality

In interviews with experienced internet users we found that from the users' point of view, it is very likely that an information retrieval or filtering problem is framed as a problem of low *quality* of information, not of low *topicality*. Although an information stream such as a mailing list or a Netnews conference is an interesting medium with occasional nuggets of interesting information, most of the material is irrelevant, uninteresting, and, simply put, of low quality. Quality is a many-faceted quality, and cannot be addressed with simple metrics - which brings us back to the problem of combining evidence addressed above.

Open Research Questions

Besides all computationally generally interesting questions and questions related to statistics and machine learning specifically there are important questions to address specifically related to information access.

Typical bare bones term-based information retrieval have weak points. The information flow between user and system is poor, and text can yield more information than the word statistics utilized by systems today.

The main hindrance to understanding text better is not faulty statistics or processing constraints, but faulty understanding of what text is and why.

A first step to understanding text better are experiments in stylistic and structual analysis of texts. They show that it is possible to extract non-topical information from texts with comparatively little bother. While it is true you get what you pay for, even shoddy analysis is informative: texts can be categorized in genres, provided the genres in question are well chosen. And this type of information can be used and has been used for both better presentation of information retrieval results and for reranking the output of probabilistic systems.

This is but a start. We need a better understanding of the small and vague clues readers use to pass judgments on texts.

References

Nicholas J. Belkin. (1994.) "Design Principles for Electronic Texytual Resources: Investigating Users and Uses of Scholarly Information", *Studies in the memory of Donald Walker*, Kluwer.

Douglas Biber. (1989). "A typology of English texts", *Linguistics*, 27:3-43.

Douglas Biber. (1988.) *Variation across speech and writing*. Cambridge University Press.

Ivan Bretan, Johan Dewe, Anders Hallberg, Niklas Wolkert and Jussi Karlgren. (1998.) "Web-Specific Genre Visualization" *Proceedings of WebNet '98*, Orlando, Florida, November 1998.

Johan Dewe, Jussi Karlgren, and Ivan Bretan. (1998). "Assembling a Balanced Corpus from the Internet". *Proceedings of the 11th Nordic Conference on Computational Linguistics*, Copenhagen.

Marti Hearst. (1997.) "TextTiling: Segmenting Text into Multi-Paragraph Subtopic Passages". *Computational Linguistics*.

Marti Hearst and Christian Plaunt. (1993.) "Subtopic Structuring for Full-length Document Access". *Proceedings of the 16th ACM SIGIR Conference on Research and Development in Information Retrieval*. Pittsburgh. New York: ACM.

Jussi Karlgren. (1990.) "An Algebra for Recommendations", *Syslab Working Paper* 179, Department of Computer and System Sciences, Stockholm University, Stockholm.

Jussi Karlgren. (1996.)"Stylistic Variation in an Information Retrieval Experiment" In Proceedings NeMLaP 2, Bilkent, September 1996. Ankara: Bilkent University. (In the Computation and Language E-Print Archive: cmp-lg/9608003).

Jussi Karlgren. (1998). Stylistic Experiments for Information Retrieval. Strzalkowski, T. (ed.) Natural Language Information Retrieval, Tomek, Kluwer.

Jussi Karlgren and Douglass Cutting. (1994.) Recognizing Text Genres with Simple Metrics Using Discriminant Analysis. Paper presented at the 14th International Conference on Computational Linguistics (COLING-94), Kyoto, July 1994. (In the Computation and Language E-Print Archive: cmp-lg/9410008).

George R. Klare (1963.) *The Measurement of Readability*. Iowa University press.

Robert M. Losee. 1996. "Text Windows and Phrases Differing by Discipline, Location in Document, and Syntactic *Information Processing and Management*. (In the Computation and Language E-Print Archive: cmp-lg/9602003).

Pattie Maes. (1994.) "Agents that Reduce Work And Information Overload". Communications of the ACM 37:7.

I. I. Menshikov. (1974.) "K voprosu o zhanrovo-stilevoy obuslovlennosti sintaksicheskoy struktury frazy". ("On genre-dependent stylistic variation of the syntactic structure in the clause") In *Voprosy statisticheskoy stilistiki*.

Golovin et al. (eds.) 1974. Kiev: Naukova dumka; Akademia Nauk Ukrainskoy SSR.

Paul Resnick, Neophytos Iacovou, Mitesh Suchak, Peter Bergstrom, John Riedl. (1994.) "GroupLens: An Open Architechture for Collaborative Filtering of Netnews", *Proceedings of CSCW 94*, Chapel Hill.

Gerard Salton and James Allan. (1994.) "Automatic Text Decomposition and Structuring", *Procs. 4th RIAO - Intelligent Multimedia Information Retrieval Systems and Management*, New York.

Tomek Strzalkowski, Louise Guthrie, Jussi Karlgren, Jim Leistensnider, Fang Lin, Jose Perez-Carballo, Troy Straszheim, Jin Wang, Jon Wilding. (1997.) Natural Language Information Retrieval: TREC-6 Report. In *Proceedings of TREC-6*, Donna Harman (ed.).

Josef Vachek. (1975.) "Some remarks on functional dialects of standard languages". In *Style and Text - Studies presented to Nils Erik Enkvist*. Hakan Ringbom. (ed.) Stockholm: Skriptor and Turku: Abo Akademi.

Donald E. Walker. (1981.) "The Organization and Use of Information: Contributions of Information Science, Computational Linguistics, and Artificial Intelligence", *Journal of the American Society for Information Science* 32, (5):347-363.

Adapting Web Information to Disabled and Elderly Users

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Abstract: Substantial research and standardization efforts already exist to make it easier for people with physical impairments to perceive and interact with web pages. This paper describes work aimed at catering the *content* of web pages to the needs of different users, including elderly people and users with vision and motor impairments. The AVANTI system and related efforts in the AVANTI project will be discussed and experiences reported.

1. Introduction

The World Wide Web is currently the most frequently visited electronic resource and is likely to become the access ramp to the electronic information highway of the next millennium. Web access should therefore ideally be available to everyone in order not to create yet another informational, and hence economical and social, disparity in society. Special efforts must be put into making the access to the web available to those who so far have been at a disadvantage, including people with disabilities and elderly people who until recently were only minority users of information technology. The terms "Design for All" and "Universal Access" have been coined to denote a design methodology for computer interfaces that does not automatically preclude users with special needs from using the system, as it often used to be the case with software developed to date.

In this context, increasing efforts are currently being made to render the web accessible to users with sensoric deficiencies. This primarily includes users with visual impairments [WAI, BrailleNet, Morley et al. 1998] and to some extent also users with motor impairments [Hermsdorf 1998, Hermsdorf et al. 1998]. Adaptations that are being researched include alternate input and output modalities (e.g., speech instead of text), adjustable behavior of user interface elements (e.g., toolbars with rotating cursor), and abridged non-visual navigation within and across web pages.

However, making the interface and the interaction with the interface universally accessible does not yet render a web site fully accessible. Users do not only have different needs with respect to perception and interaction, but also with respect to the information that is conveyed through the web. Users with certain disabilities often have specific information needs that are not shared by other users (e.g., information on wheelchair accessibility for motor-impaired people). Likewise, they are not very interested in certain information that may be important to other users (e.g., information about musical events for deaf users).

The amount of additional or different information required by certain user groups is sometimes quite sizeable. It would be a burden for all other users if this information were presented to everybody. This paper discusses principles to also apply a user-friendly design-for-all principle to the information that is being presented on the WWW, in addition to applying it to the interface and the interaction with the interface. The approach taken consists in the adaptation of the information to the individual information needs of each user, as expressed in a user model of each user. Research in the AVANTI project [Fink et al. 1999] will be described that developed the prototype of a comprehensive tourist information system for a wide range of users, including people with disabilities and elderly users.

2. Special Information Needs

In the area of tourism, a wide variety of different information needs can be observed. They stem from different interests, knowledge, preferences and physical abilities of each individual user. A user needs analysis that was carried out in the context of AVANTI revealed the following special information needs, among many others [Bini 1996].

Mobility-impaired people require substantially more information than able-bodied users and any other disability group. (This information is mostly redundant for these other users and should be omitted when presenting information to them). For wheelchair-bound users, detailed information concerning the accessibility of buildings (e.g., the existence and the dimensions of ramps and elevators, the type and width of doors, the type of floor covering) is important and should therefore be automatically provided. They should also be warned unsolicitly when routes present insurmountable obstacles (like steps and slopes with a gradient of over 15% lengthwise and over 2% sideways) or when routes are very difficult to master (e.g., routes with a gradient between 8% and 15%, or routes with plenty of traffic).

For blind users, not only the modality of the presented information must be changed to tactile and/or audio output; in addition, supplementary orientation and navigation aids, like an additional table of content containing all internal and external links on a hypermedia page, are helpful [Kennel et al. 1996]. They should also be automatically warned of the presence of mobile obstacles, acoustic pollution, and long distances that need to be conquered without tactile or acoustic clues, since these are the main mobility barriers for this user group.

Elderly users are sometimes included in categories of serious handicap due to age and health conditions and should receive the respective special information. They should also be automatically warred of the presence of narrow or spiral staircases, slippery surfaces unaided by hand rails, and long distances that need to be conquered without rest or relief points. Escalators, elevators and restrooms should be particularly marked out.

The need for specialized information however does not only stem from disability needs. In any information system, the following distinctions between users should be made, among many others:

- Users who are interested in a specific subject area should automatically receive more detailed information on it than users who lack this interest.
- For computer novices, usage instructions should be augmented by an explanation. This is normally not necessary for experienced computer users.
- For users with low-bandwidth network access (e.g., via a slow modem), information with high data volume (e.g., videos and high-resolution pictures) should be replaced by less demanding, but nevertheless appropriate equivalents, in order to reduce download times. The response time of a hypermedia system is extremely critical from a usability point of view [Nielssen 1990].

In order to cater to these different information needs of users, techniques from the area of adaptive hypertext and hypermedia systems [Brusilovsky et al. 1998] have proven to be very useful. These systems dynamically generate hypermedia pages based on constantly updated assumptions about the user that are stored in a user model [Kobsa 1993].

3. Overview of the AVANTI System

AVANTI is a WWW-based tourist information system that adapts web pages to each user's individual needs before presenting them to the user. The system provides hypermedia information about a metropolitan area (e.g., about public services, transportation, buildings) for a variety of users (e.g., tourists, citizens, travel agency clerks, elderly people, blind persons, wheelchair-bound people, and users with slight forms of dystrophy[1]) with different interests, knowledge, and abilities. The system can be accessed from people's homes, from travel agencies, public information kiosks and on the go. Users' hardware platforms, software environments, network speeds, and environmental surroundings thus vary widely. In order to cater to the different user needs and usage environments, AVANTI exploits methods and tools developed in the context of adaptive and adaptable systems [Oppermann 1994], user modeling [Kobsa 1993] and adaptive hypertext and hypermedia systems [Brusilovsky et al. 1998].

AVANTI consists of the following main components:

- Multimedia Databases with information about the AVANTI domain in different modalities (mostly text, images, and videos). They also include a restricted data model.
- The User Model Server which hosts models of all users. These models primarily contain information about users' abilities and to some extent assumptions about their interests.
- The Information Resource Control Structure (IRCS), a repository of mostly generic web pages that include links to database entries and rules for user-adaptation based on the current user model. IRCS pages are encoded in an extension to HTML.

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[1] Dystrophy is a range of circa 40 neuromuscular diseases resulting in muscle weakness, paralysis, cramps, impaired muscle relaxation, etc.

- A Hyperstructure Adapter that generates user-adapted hypermedia document descriptions on the basis of the IRCS and the current user model.
- A User Interface that presents these hypermedia pages and performs necessary adaptations on the level of the user interface, particularly concerning the selection of appropriate modalities and interaction forms.

AVANTI acquires assumptions about the user based on the following sources of information:

- A short *initial interview* allows for the acquisition of primary assumptions [Pohl et al. 1995] about the user and is therefore a valuable source of information for initially assigning the user to certain user subgroups (see the "stereotypes" below).
- Basic information about users' disabilities can be stored on a contactless *smartcard* that can be read from a distance of about 40-80 cm (15-30"), depending on the electromagnetic surroundings. Such a smartcard can record, e.g., information about users' visual and manual disabilities, so that AVANTI can adapt the modality of and the interaction with the interface while the user is approaching the system. Fig. 1 shows an example: here the fact that the current user is mildly vision-impaired is stored on the smartcard and read with the antenna around the monitor. This information then automatically leads to screen magnification.
- Based on primary assumptions about the user and additional information about the application domain, the system can draw *inferences* in order to acquire further assumptions about the user. For instance, if the user requests more than once detailed information on the history of some churches, he/she can be assumed to be interested in churches, and this detailed information will henceforth be automatically provided.
- *Stereotypes* [Rich 1979] contain assumptions about interesting characteristics of user subgroups (e.g., the presumable knowledge of domain experts or the presumable interests of wheelchair-bound users). If certain preconditions are met, a stereotype can be activated for a specific user, which means that the assumptions contained in the stereotype become assigned to the user.

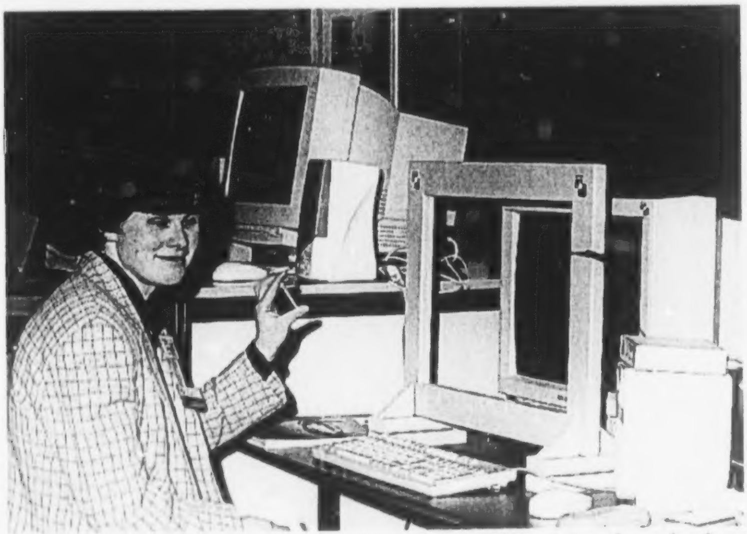
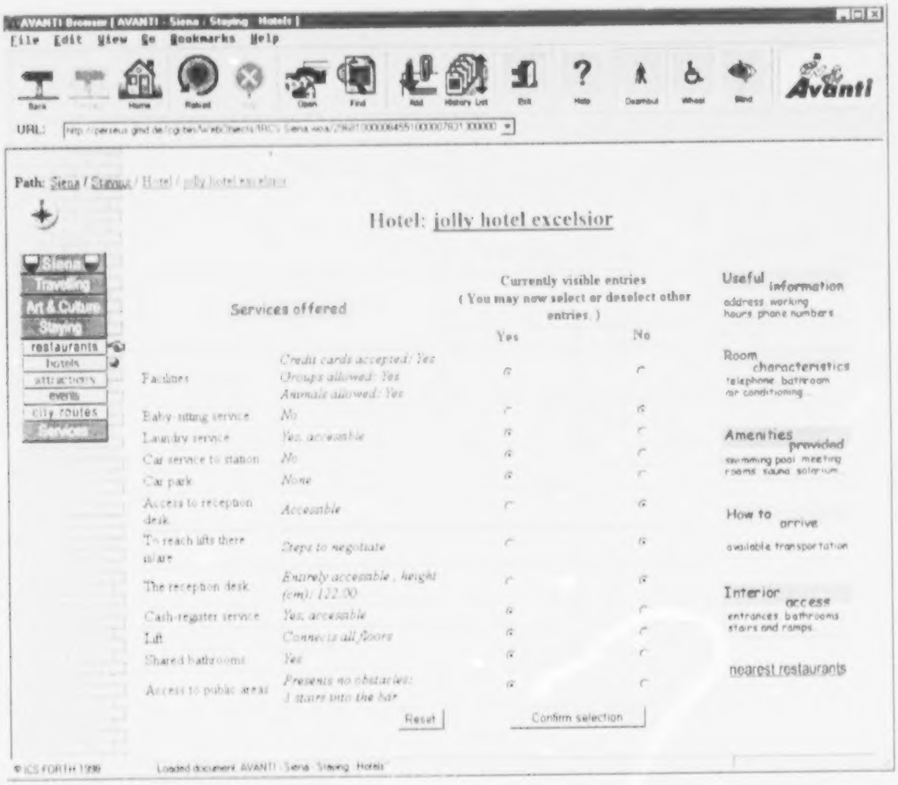


Figure 1: Automatic screen magnification for a mildly vision-impaired user after reading the user profile on the smartcard from a distance

4. An Example of Adabtability in AVANTI

The web page depicted in Fig. 2 informs about the services, facilities and amenities that are available in "jolly hotel excelsior" in Siena, Italy. The page can be separated into three areas. The left column with the brick-pattern background contains mostly the main menu. The central area contains the "real" information (e.g., the services offered by a hotel), and the right column includes menu buttons that point to other relevant information.

In its present form, the page is tailored to a user who is experienced in using both computers and the AVANTI system and needs special information for wheelchair-bound and dystrophic people (information about these needs would come from an initial questionnaire or a contactless smartcard). For instance, the optional navigation path displayed in the upper left corner is only available to experienced web users since its usage requires at least a coarse mental model of the hypermedia space at hand. This path is therefore left out for web novices and their navigation tools restricted to the hierarchical Siena menu on the left-hand side since such users may be confused by alternative navigation elements on a hypermedia page. The hand icon pointing to "restaurants" and the link "nearest restaurants" in the lower right corner are pointing to information that is presumably interesting for the current user. Such an assumption is acquired by the system through inference mechanisms based on the navigation history. For instance, if the user requests more than once detailed information on the cooking style of some restaurant, she/he can be assumed to be interested in restaurants.


AVANTI Browser [AVANTI - Siena - Staying - Hotels]
File Edit View Go Bookmarks Help
Back
Home
Reload
Open
Find
Add
History List
Exit
Help
Deambul
Wheel
Blind
Avanti
Siena
Travelling
Art & Culture
Staying
restaurants
hotels
attractions
events
city routes
Services
Useful information
address, working hours, phone numbers
Room characteristics
telephone, bathroom, air conditioning...
Amenities provided
swimming pool, meeting rooms, sauna, solarium...
How to arrive
available transportation
Interior access
entrances, bathrooms, stairs and ramps
nearest restaurants
Reset
Confirm selection
© ICS FORTH 1998

URL: http://perseus.gmd.de/cgi-bin/WebObjects/IRC/Siena.woa/29621000006455100000783130000

Path: Siena / Staying / Hotel / jolly hotel excelsior

Hotel: jolly hotel excelsior

Services offered		Currently visible entries (You may now select or deselect other entries.)	
		Yes	No
Facilities	Credit cards accepted: Yes Groups allowed: Yes Animals allowed: Yes	●	○
Baby-sitting service	No	○	●
Laundry service	Yes, accessible	●	○
Car service to station	No	●	○
Car park	None	●	○
Access to reception desk	Accessible	○	●
To reach lifts there is/are	Steps to negotiate	○	●
The reception desk	Entirely accessible , height (cm): 122.00	○	●
Cash-register service	Yes, accessible	●	○
Lift	Connects all floors	●	○
Shared bathrooms	Yes	●	○
Access to public areas	Presents no obstacles: 3 stairs into the bar	●	○

Loaded document 'AVANTI - Siena - Staying - Hotels'

Figure 2: Example of Adaptive and Adaptable Elements in an AVANTI web page

Other optional elements are the so-called *role-taking buttons* in the toolbar of the AVANTI browser. The upper right corner contains the role-taking buttons "Deambul" for deambulation (walking around), "Wheel" for wheelchair, and "Blind"[2]. The availability of these buttons is also contingent on the AVANTI expertise of the user. If one or more of these buttons are pressed (e.g., "Deambul" and "Wheel" in Fig. 2), the user automatically obtains additional information for the selected user groups (e.g., additional information for dystrophic people with difficulties walking around and wheelchair-bound persons, respectively). These buttons were designed for people

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[2] These buttons, as well as the "Exit" and "Help" buttons, are part of the page descriptions coming from the HSA. They are included in the AVANTI browser while its HTML parser is processing the page. Since the HSA behaves like a "normal" web server, it is also possible to access the HSA with any commercial browser. The extra buttons will then remain in the HTML page.

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who look for information on behalf of disabled persons. For instance, travel agency clerks can "take the role" of a wheelchair-bound customer while working with the AVANTI system. From a technical point of view, the role-taking buttons can be used to activate or deactivate certain stereotypes (i.e., "Dystrophic User", "Wheelchair User" and "Blind User").

In AVANTI, tables presented to the user contain those attributes only which the system deems to be relevant for him/her according to the current user model. The user is able to modify the system-initiated attribute selection by requesting an adaptable version of the table that includes all available attributes. Fig. 2 shows such an adaptable version where the user has de-selected "Baby-sitting service" and some other attributes and subsequently confirms his/her de-selection.

5. Experiences with AVANTI

The AVANTI system has been subject to extensive summative evaluations at three different cities in three different scenarios with a total of 180 subjects [AVANTI CD-ROM, Andreadis et al. 1998]. Users were tourists, business travelers, citizens, travel agency clerks, and users with vision and motor impairments. The common question shared by all experiments was whether the developed system is beneficial for users, and specifically whether it is technically feasible and useful for end users to introduce adaptability and adaptivity in the information content and user interfaces of hypermedia information systems.

Users were subject to usability tests to determine the system's learnability, efficiency of use and memorizability, users' error-proneness, satisfaction and overall attitude, and the specific contribution of adaptability and adaptivity. Data were collected through observation, interviews, questionnaires and the analysis of log files. The results allow one to conclude that AVANTI's adaptation features were generally well understood, used, and appreciated (some of them were not self-explanatory though) and that the benefit for information systems probably lies more in user satisfaction than in efficiency gain or error reduction.

A general finding was that experienced users are more inclined to take advantage of adaptability features than users with less experience. While adaptability features have been recognized and understood by most users, they have been more frequently used by AVANTI experts (namely adaptive tables), and computer and web experts (namely the path navigation tool). Travel agency clerks liked the possibility to create their own shortcuts.

Travel agents also appreciated very much the role-taking buttons. These buttons were generally well recognized, correctly understood, and frequently used.

Motion-impaired users were generally more satisfied with the information provided by the system and had a better attitude towards AVANTI than able-bodied users. They found the system properly designed for them and the information on accessibility very clear and useful for mobility. They also appreciated very much the level of detail reached by the system, and many of them praised the system enthusiastically. In contrast, able-bodied users did not easily find information for their purposes (and often this information was not present in the system). It also seems that their concept of mobility differs from that of impaired users in several ways, and was not properly reflected in the system.

6. References

[Andreadis et al. 1998] Andreadis, A., Gianetti, L., Marchichiagni, E., Rizzo, A., Schiatti, E., Tiberio, M., Pentila, M., Perala, J., Emiliani, P., Bini, A., Nill, A., Sabbione, A., Sfyrakis, M., Stary, Ch., Totter, A. (1998): Global Evaluation of the Experiments. ACTS Deliverable AC042-DE030 (project AVANTI), Brussels.

[AVANTI] AVANTI Home page. http://www.avanti-acts.org/

[AVANTI CD-ROM] http://fit.gmd.de/hci/projects/avanti/cd-rom/start.htm

[Bini 1996] Bini, A. (1996): User groups' needs and requirements. Deliverable AC042-DE001 (Project AVANTI), Brussels.

[BrailleNet] http://www.braillenet.jussieu.fr/ntevh_ang.htm

[Brusilovsky et al. 1998] Brusilovsky, P., Kobsa, A., Vassileva, J. (1998): Adaptive Hypertext and Hypermedia Systems. Dordrecht, Netherlands: Kluwer Academic Publishers.

[Fink et al. 1999] Fink, J., Kobsa, A., Nill, A. (1999): Adaptable and Adaptive Information Provision for All Users, Including Disabled and Elderly People. To appear in New Review of Hypermedia and Multimedia. Also available from http://fit.gmd.de/~kobsa/papers/1999-NRMH-kobsa.ps

[Hermsdorf 1998] Hermsdorf, D. (1998): WebAdapter: A Prototype of a WWW Browser with new Special Needs Adaptations. In Edwards, A., Arato, A., Zagler, W. (eds.): Proceedings of the XV IFIP World Computer Congress, Computers and Assistive Technology ICCHP '98, Vienna/Budapest 1998, pp. 151-160.

[Hermsdorf et al. 1998] Hermsdorf, D., Gappa, H., Pieper, M. (1998): WebAdapter: A Prototype of a WWW-Browser with New Special Needs Adaptations. In: Proceedings of the ERCIM Workshop "User Interfaces for All: Towards am Accessible Web", Langholmen, Stockholm 1998. Available from http://www.ics.forth.gr/proj/at-hci/UI4ALL/UI4ALL-98/hermsdorf_ps.zip.

[Kennel et al. 1996] Kennel, A., Perrochon, L., and Darvishi, A. (1996): WAB: World-Wide Web Access for Blind And Visually Impaired Computer Users. New Technologies in the Education of the Visually Handicapped. ACM SIGCAPH Bulletin, June 1996. Available at http://www.inf.ethz.ch/department/IS/ea/blinds/.

[Kobsa 1993] Kobsa, A. (1993): User Modeling: Recent Work, Prospects and Hazards. In: Schneider-Hufschmidt, M., Kühme, T., Malinowski, U.: Adaptive User Interfaces: Principles and Practice. North-Holland: Amsterdam.

[Morley et al. 1998] Morley, S., Petrie, H., O'Neill, A.-M., McNally, P. (1998): Auditory Navigation in Hyperspace: Design and Evaluation of a Non-Visual Hypermedia System for Blind Users. Proceedings of ASSETS '98, the Third Annual ACM Conference on Assistive Technologies. Marina del Rey, CA, 100-107. Also available at http://phoenix.herts.ac.uk/SDRU/pubs/ACCESS/MorlPetr.htm.

[Nielsen 1990] Nielsen, J. (1990): The Art of Navigating through Hypertext. Communications of the ACM, vol. 33, no. 3, 1990, 296-310.

[Oppermann 1994] Oppermann, R. (Ed.). Adaptive User Support - Ergonomic Design of Manually and Automatically Adaptable Software. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., Publishers.

[Pohl et al. 1995]: Pohl, W., Kobsa, A., Kutter, O. (1995): User Model Acquisition Heuristics Based on Dialogue Acts. Proceedings of COOP'95: International Workshop on the Design of Cooperative Systems, Antibes-Juan-les-Pins, France, 471-486. Also available at http://fit.gmd.de/~kobsa/papers/1995-COOP95-kobsa.ps.

[Rich 1979] Rich, E. User Modeling via Stereotypes. Cognitive Science, 3, 1979, 329-354.

[WAI] WAI Homepage. http://www.w3.org/TR/WAI-WEBCONTENT/

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THE LEGAL OBSTACLES AND THE PROBLEM OF TRUST ON THE INTERNET

by

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Introduction

When doing eCommerce on the Internet the various country-specific legislations are often a potential risk to companies that want to leverage the global aspect of the Internet and new markets. Especially data protection and copyright represent two of the main hurdles - just by comparing the US situation to the European situation one can see the legal difficulties emerging out of real global eCommerce.

The data protection directive 95/46/EC that is effective since 24th October 1998 has an enormous impact on multinational companies and such companies that operate globally but process their data outside of the European Union. The directive restricts process of of data from EU citizens outside the European Union if the country/specific organization that would like to process the data does not have adequate laws or guidelines embodied. International copyright issues have always represented another obstacle especially when trying to protect a product that can be downloaded from the Internet and modified easily.

Another interesting aspect is based on the different views about offers on the Internet. When doing eCommerce in Europe an offer on the Internet has not the same meaning and legal enforcements in the back than an Internet offer would have in the US. Digital signatures represent a way to settle contracts on the Internet and enhance security, however their legal basis varies tremendously throughout the world aligned with different liabilities - a truly international question addresses acknowledging and accepting different country-specific certificates.

Partly because of the legal difficulties but also because of the uncertainties in association with the Internet, trust is a big concern when doing eCommerce. A variety of trustmarks for different areas has been evolving lately, however the approaches are different and not often of the same quality.
The biggest challenge for secure eCommerce is going to be the unification of legal aspects, their enforcements and increasing the trust on the Net.

Data Protection and the Internet

Privacy and data protection always has been a big concern for individuals, especially in countries without a proper legislation. While the business for „information brokers" booms in the US, the European Union (EU) enhances individual and corporate data protection. The data protection directive 95/46/EC which came into effect in October 1998 was not seen as a threat to most European companies, as they already had strong country-specific legislation on data protection. However, it was big threat for US based multinational companies (MNC) that processed EU-data outside of the EU.

Article 1 - Object of the Directive - already states that the directive is aimed to protect the fundamental rights and freedoms of natural persons, and in particular their right to privacy with respect to the processing of personal data. This article changed already many European country specific legislations as it refers to „natural"

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persons, which means individuals as well as companies with an own legal entity. Usually the former data protection laws mostly covered the rights of individuals, but not companies with an own legal entity.

In Article 6 that belongs to Section I - Principles relating to Data Quality - obligations for the Member States are listed that explicitly state points such as fairly and lawfully processing of data, collecting of data for specified, explicit and legitimate purposes and not further processing in a way incompatible with those purposes, accuracy of data (when necessary kept up to date) and time limitation on data usage. This Article alone raises questions on its application when doing eCommerce on the Internet. Most of the times you see an Internet Webpage, you are not told upon the purpose of data collection, or how the data is kept accurate or processed fairly.

Article 7 states the criteria for making data processing legitimate, whereas the very first objective is that the data subject „has unambiguously given his consent“, or „processing is necessary for the performance of a contract to which the data subject is party or in order to take steps at the request of the data subject prior to entering into a contract“. Article 7 states more criteria, however these two are essential for eCommerce. It is already critical if e.g. an US company puts a questionnaire on the Internet and an EU-citizen fills out this questionnaire as part of a purchasing process, however the questionnaire asks for information that cannot be directly related to the purchase order. It is an unresolved issue whether just pressing the „submit“-button can be interpreted as giving consent unambiguously.

Completely new is Article 8 of the data protection directive that states a very special sort of data. The article says „Member States shall prohibit the processing of personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade-union membership, and the processing of data concerning health or sex life“. Of course, if an individual gives his explicit consent, one may process the data (if not definitly prohibited by the Member State anyway), also under certain other conditions that are stated in paragraph 2 of Article 8, but the essential thing starts when data is being joined in that area. Here comes a little example: An Austrian pharmacy wants to do eBusiness and offers pre-order of medicine on the Internet. All the customer has to do is pick up the medicine with the according perscription. Just this information is harmless, but if you link the certain disease to the medicine to the customer it already looks different. Just thinking of unauthorized disclosure of this data might lead to significant impact in insurance (the customer is probably only offered a high insurance) and other areas of life. In Europe this is no problem, as current country-specific data protection usually prohibits linking of data, but when the data gets outside the us, this might cause problems.

Especially of interest for companies are Article 16 and 17 upon Confidentiality and Security of Processing. Article 17 states „Member States shall provide that the controller must implement appropriate technical and organizational measures to protect personal data against accidental or unlawful destruction or accidental loss, alteration, unauthorized disclosure or access, in particular where the processing involves the transmission of data over a network, and against all other unlawful forms of processing. This certainly impacts the organization

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of many European companies and global MNCs as it implies that the organization has to provide sufficient logical and physical access security, efficient monitoring and documentation of data processes, auditing features, a well-defined backup system, business continuity planning, etc. Many European companies, especially in the Central European area, are currently still lacking of this functionality. In many cases a business continuity plan is only referred to as diseaster recovery for the IT-system, backup-tapes are stored within the server room (which might reduced usefulness in case of a fire...), physical access of the server rooms are not sufficient, logical access models are just based on departments within the company but not on the roles of an individual (which might lead to insufficient access control), auditing functions of operating systems, etc. are not enabled, documentation is done rarely and monitoring of IT-system security is not always efficient enough. Unfortunately not many companies see these points as critical to their success, so a company with well defined IT-guidelines for IT-system security and especially data protection is more the exception than the rule (especially in Central Europe).

Chapter IV - Transfer of Personal data to Third Countries has the biggest impact when talking about global eCommerce. The transfer of data to a third country - undergoing processing or where it is intended for processing - is only permitted if the third country ensures an adequate level of protection as the EU directive (Article 25). It is possible to transfer the data without this adequate level of protection if the data subject has given his consent unambiguously to the proposed transfer, or the transfer is necessary for a contract between the data subject and the controller, or reasons such as public interest or interest of the data subject. The permission can also be given when a certain company has adequate level of protection as the EU directive.

Especially in the US-region Privacy Policies have evolved due to the lack of adequate data protection regulation. However, these Privacy Policies differ highly in quality as well as enforcement. Non-profit organizations such as truste aim to embody standards for Privacy Policies for WebPages, but so far there is still a lot of work to do to find a common, global framework and standard for privacy protection.

International Copyright Issues in eCommerce

Copyright issues have been a hot topic recently when doing business on the Internet. „Copyright" can be defined as an exclusive right that embraces aspects of moral rights and property rights. It guarantees the creator and the producer of a work control over and participation in the commercial expliotation of the protected work and subject matter. The Internet offers a big source for downloading or copying protected work and subject matter without spending much money and without any timely loss or quality decrease.

Currently there is no such a thing as a global copyright law, and it probably will not exist in the near future. However as the Internet is related to a global aspect the country-specific-legislation problem is increasing.

Copyright is an immaterial right and represents the right to which the creator of a literary, scientifc or artistic work is entitled in his or her immaterial work. There is nothing easier than downloading or copying a picture

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from somebody else's WebSite and reproducing it. The act of reproduction is goverend by the law of the country in which the reproduction takes place. There is a difference between making work in digital form off-line available or on-line. If it is made available on-line we have the problem of the dispute which right is applicable in case of e.g. the Internet. One theory is called the „theory of country of emission“ and it states that the law of the country should apply where the work was made available on-line, and all laws of the receiving countries remain unimportant. Another theory is called the „country-of-reception theory“ and states that the entire process of a cross-frontier availability should satisfy the copyright law not only of the broadcasting state but also the copyright laws of all receiving countries.

The EU issued the Directive for the Legal Protection of Databases in 1996 where it states that databases attract copyright protection with respect to their originality of their selection or arrangement. Again this Directive was aimed to embody a unified approach within the Member States to copyright issues and databases. A sui generis right was created against unautorized extraction and/or re-utilization of the whole or of a substantial part of a database, where the preparation of the database required „a substantial investment“.

Another copyright issue is the management of Internet names and addresses. Only a short time ago, the World Intellectual Property Organization (WIPO) issued a paper called the „WIPO Internet Domain Name Process“[1]. Domain-name-grabbing was a very popular „sport“ and could result in significant money. The domain names are defined as „human-friendly form of Internet addresses“ in the above mentioned WIPO report and they caused significant problems when the Internet and electronic commerce grew. A domain name can be registered within certain local companies and is completely under private control. However, Domain Names provide a link between the Internet and a trademark and other recognized rights. Currently it is still up to the country-specific legislations how to handle conflicts between trademark owners and domain name holders. The problem increases significantly when the domain name is in conflict with another company that is not in the same country. The WIPO states in Paragraph 132 of its paper: „Because a domain name gives rise to a global presence, the dispute may be multijurisdictional in several senses. The global presence may give rise to alleged infringements in several jurisdictions, with the conseuence that several different national courts may assert jurisdiction, or that several independent actions must be brought because separate intellectual property titles in different jurisdictions are concerned“.

This is not the only problem as outlined by the paper. Another one may arise between generic top-level domains and country code top-level domains. Because of many of them exist and because each of them gives the same access to global presence, the same dispute as stated above may manifest itself in many of the top-level domains.

It should be noted that the economic value of damage that can be done as result of domain name registration or domain-name grabbing is far higher than just the cost of simply obtaining that domain name. As speed is key in the Internet the problem has to be solved, otherwise companies can lose significant money e.g. because of

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destroying brand image. Currently, resolving a domain name dispute may be urgent, but still may not be done appropriately, slow and very expensive in various countries.

Court litigation is goverend by the civil law of the different states.

Contractual issues and the impact of digital signatures

Most people have already heard about the case of David J. Loundy[2], an attorney and author. He unfortunately came in touch with the differences of contractual law in the US and Europe when he wanted to buy a CD at its listed price from his favourite rock group. The CD was listed on the Internet to another price as what Loundy got invoices due to a list-price-error on the Webpage. Within the European legislation (in this case: UK), there was no contract by ordering the CD via Internet, as the WebSites „offer" was actually only an „invitation to treat". The problem grew further when asking what legislation should be applied - the UK law or the place of the fulfillement of the „contract" - Illinois, US.

The question of what legislation will apply within eCommerce is still unresolved. There is no definite answer as services offered and their fulfillement differ, and in mostly it depends on the case itself. In the EU a proposal for a European Parliament and Council Directive on certain legal aspects of electronic commerce in the internal market (1999/C 169/14) was issued in 1999. The aim of the directive as stated in the Official Journal of the European Communities (C169) from 16th June 1999 is „to promote the spread of electronic commerce by helping break down legal barriers to trade". The proposed directive addresses five key areas to establish a coherent framework among its Member states[3]:

- Establishment of providers of information society services: Providers have to fulfil specific information requirements in order to ensure the transparency of their activities.
- Commercial communications such as advertising, direct marketing, etc: Commercial communications have to be clearly recognizable a such, and the parties on wholse behalf they are made must be clearly identifiable.
- Contracts: Member States have to adjust their national legislation to the common platform in the EU. The proposal wants to remove legal uncertainties by clarifying in certain cases the moment at which a contract is deemed to be concluded. In Article 11 it states that to conclude a contract with legal effect, the service provider must issue an acknowledgement of receipt, which must be reconfirmed by the buyer. However, the term „offer" is still not clearly defined enough as Member States still handle this issue differently (see above mentioned case with Mr. Loundy).

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[1] Final Report of the WIPO Internet Domain Name Process, World Intellectual Property Organization, April 30, 1999 <http://wipo2.wipo.int>

[2] David Loundy's E-Law Web Page. <http://206.54.248.130/>

[3] Official Journal of the European Communities, C169, 16.6.1999, pp. 36 - 42.

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- Liability of intermediaries: Especially on-line service provider liability is part of this section, where transmitting and storing third party information is discussed.
- Implementation: Community-level codes of conduct and administrative cooperation between Member States has to be established.

A significant step into the right direction to solve contractual questions especially related to risks such as data integrity and authentication is the usage of digital signatures. Looking at this issue within a global perspective, one finds various different digital signature laws. Only by taking the USA as an example there are different digital signature laws in almost every state. To form a common platform for trade it is significant to have a unified understanding and a globally accepted standard for the usage of digital signatures and acceptance of digital certificates.

The EU has issued a proposal for a European Parliament and Council Directive on a common framework for electronic signatures[3] which was submitted by the commission on 16 June 1998 and amended in January 1999. It establishes a set of criteria which form the basis for legal recognition of electronic signatures. The proposed Directive focuses particularly on certification services and sets a minimum standard for Certification Service Providers (CSP) and certificates to ensure cross-border recognition of signatures and certificates within the EU. The approach of the directive is technology neutral. The Directive is aimed to increase the level of security and trust among the Member States and the proposal introduces liability rules for the CSP. The biggest challenge for digital signatures within a global aspect is going to be global recognition and quality assurance of service as well as liability and enforcement. The current state shows already the hurdles and the long-term problems evolving starting from discrimination if e.g. a CSP offers his services only to related clients of his core services (e.g. banks as CSPs, insurance companies, etc.), minimum security standards, quality of work, certification of issuing the root certificate, etc. Different types of digital certificates are going to evolve that are related to certain strength when signing with a digital signature. It is essential to find a global platform for digital signatures to enhance electronic commerce and to make it more secure.

Trust on the Internet - the evolving trustmarks and their approaches

Electronic Commerce is associated with certain risks that can be classified in four broad categories:

- Authenticity: Is the business partner really the one he says he is?
- Integrity: Is the data I received/see still the one that was sent/originally created, or was the data modified?
- Non-repudiation: Can I claim the proof of shipment and/or receipt of data?
- Confidentiality: Is the data protected from unauthorized or unintended disclosure or observation?

All of these risks are by nature associated with financial loss if they occur. They serve as inherent part of the business risk, and if no controls are enforced within a company they increase the risk of financial damage.

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[3] Proposal for a European Parliament and Council Directive on a common framework for electronic sigantures. Document 598PC0297, <http://europa.eu.int/eur-lex/com/dat/1998/en_5989PC0297.html>

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Because of the various legal obstacles and the above mentioned risks within electronic commerce and the Internet, trust has become a critical success factor for ebusiness. Only those companies that are „trusted" on the Internet can engage their customers in significant interaction which furthermore leads to competitive advantage.

Many companies have already seen this need for trust on the Internet and offer a variety of trustmarks aimed for different target groups.

The most famous trustmark in the privacy area is TRUSTe[3], a non-profit organization that aims to increase data protection and privacy on the Net. The idea behind the trustmark was governed by two principles: (1) Users have the right to informed consent; and (2) No single privacy principle is adequate for all situations. These two prinicples are the building blocks for TRUSTe's privacy work. Currently TRUSTe offers three levels of privacy assurance:

- **No exchange** provides for user anonymity
- **1-to-1 exchange** provides that private data will be kept ony by the WebSite for the use with that specific user
- **3rd party** states that the site will provide the information to third parties, beyond the site's influence.

By clicking on the trustmark one can reveal the site privacy policy the the TRUSTe site. Only a small percentage of sites will receive on-site auditing though.

Another approach is used by AICPA WebTrust which certifies business practice, transaction integrity and information protection. To gain this certificate an AICPA/CICA licensed CPA/CA serves as assurance provider. The company that wants to have this trustmark has to obtain an unqualified report from the assurance provider for the criteria in information protection, transaction integrity and business practices. Then the assurance provider contacts the seal manager (i.e. VeriSign) to issue the seal and provides the Java applet to the business. The seal has to be maintained through regular updates by the assurance provider whereas the intervals may be no less than 90 days.

A trustmark that was especially designed for security is the NCSA Web Certification Program. Therefore the company that wants to obtain such a seal has to complete a web certification field guide to prepare for evaluation. Then the NCSA evaluates the field guide to determine if the site meets the requirements for an adequate „security posture". This is followed by an on-site verification by NCSA or a partner. If the site passes the test, it receives the seal and a report is issues. The certification is typically good for one year. NCSA/agents can perform random audits.

The Better Business Bureau (BBB) trustmark provides business practice certification. If a company has been in business for a minimum of one year (with limited exceptions) and if it has a satisfactory complaint handling record with the BBB, it can get the trustmark issued. The trustmark is aimed for consumer care and consumer protection. The company needs to agree to participate in BBB's advertising self-regulation program and has to respond promptly to all consumer complaints. It has to agree to binding arbitration, at the consumer's request, for unresolved disputes involving consumer products or services advertised or promoted online.

These and other trustmarks are aimed for special niches of interest to end-consumers as well as other businesses, however the correct audit approach and maintenance are key factors for reliable trust. An eBusiness is most of the times very complex and the to-be-seen front-end online shop is only the top of the iceberg. To ensure a certain process the auditor has to cover not only the mega- but also the major- and sub-processes and evaluate built in controls. There is always a very high audit risk if the trustmark wants to deliver reliable trust, and not many companies are willing to take this risk. This determines often the quality of trust associated with a certain trustmark.

Conclusion

A variety of issues still has to be solved for successful and secure electronic commerce. The Internet is still the space for people and companies where they have to deal with legal obstacles, especially within a global aspect. The differences of recognition for the need of unified platforms on Internet related regulation can be seen clearly amongst the country-specific legislation. The EU tries to put minimum standards for electronic commerce in place to create a secure marketplace for its member states.

One can see various initiatives and action taking place as companies recognize the need for trust on the Internet and its direct relation to profitability. However, these initiatives should not only be profit based but also aimed to create a more reliable and trustworthy Internet where electronic commerce can take place.

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[1] Truste <http://www.truste.org>

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Telematics Applications for High Quality Educational and Clinical Support to Practicing Professionals and Medical Students

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Abstract. The era we are living in is often referred to as "the age of communication". The combination of new and rapidly developing interactive multimedia computers and applications with electronic networks will require a restructuring of our traditional approach to strategic planning and organizational structure. World-wide telecommunication networks (using satellites, cable) are now facilitating the global pooling of healthcare information and medical knowledge independent of location. The G7 Global Healthcare Applications Project aims at improving quality and cost efficiency of healthcare delivery through telematics (remote access) tools. From these ten sub-projects two sub-projects are presented. The development of multimedia information and communication systems demands cooperative working teams of authors, who are able to master several areas of medical knowledge as well as the presentation of these in different multimedia forms. The assemblage of telematics and services offers a base for multimedia applications, for example teleteaching, telelearning, telepublishing, teleconsulting, teleconferencing, telemedicine etc. The expansion of the internet will also lead to the formation of interdisciplinary "Global Education Networks". The theory and practice of education are undergoing dramatic changes. Lifelong learning and adaptation of medical practice to new knowledge and new techniques will be even more important in the future.

1. Using Multimedia Technologies for Education

The internet technology is rapidly emerging as the most powerful medium of mass communication. Its WWW (World Wide Web) service has become a very important media for providing medical knowledge. Printed publications are more and more supplemented by electronical methods of publishing. Unfortunately the kinds of knowledge presentation in electronical media are often very similar to the traditional "patterns" that are used in printed books and scientific journals and are often only supplemented by hyperlinks and multimedia elements. The development of multimedia information and communication systems therefore demands cooperative working teams of authors, who are able to master several areas of medical knowledge as well as the presentation of these in different multimedia forms (text, graphics, images, audio, video). This way has opened up new possibilities and qualities for the training of medical students in universities and for further education of hospital physicians as well as for practicing professionals. The user's interaction with the information is made possible by visualization and simulation. Of significant importance are the possibilities of simulating diagnostic and therapeutic methods close to reality so that patients later can be treated more precisely by a perfectly prepared team. The learners can vary the parameters of experimental series of tests independently. In addition to internet services, the medical information is offered on CD/DVD-ROM and can be used in multimedia PCs. Such offline-media does not cause a pressure of time by the user and allows repetitions whenever necessary.

Often electronic publishing groups offer medical information systems online as Web based multimedia communication systems (for instance the Health Online Service multimedica [www.multimedica.de], Physicians Online [www.po.com], Virtual Hospital at the University of Iowa [www.vh.org]). Such systems contain knowledge from renowned experts. Special support for diagnostic and therapeutic strategies are available. These Web applications are useful for distance education and training of practicing physicians, specialists of all fields in practice and clinical environments, students as well as providing health news for patients and consumers.

2. Teleconsultation Using PC Based Video-Conferencing Equipment

Telematics services are becoming essential parts of health care strategies. The increasing demand for rapid transmission of medical visual information for purposes of telepathology and education poses difficult challenges in image compression techniques. Under consideration of international standards (H.320, H.323) for PC video-conferencing equipment, online teleconsultations with remote medical experts for cooperative discussion and interactive handling of medical data and pictures/images/frames are made possible. Pictures that can be used can include still images such as frozen sections or x-ray images as well as moving frames such as ultrasound. Figure 1 shows a cooperative discussion using Microsoft Netmeeting's Whiteboard between the Institute of Neuropathology of the Hannover Medical School (Germany) and the National Cancer Research Institute in Tokyo. A discussion using a remote ultrasound image is shown in figure 2.

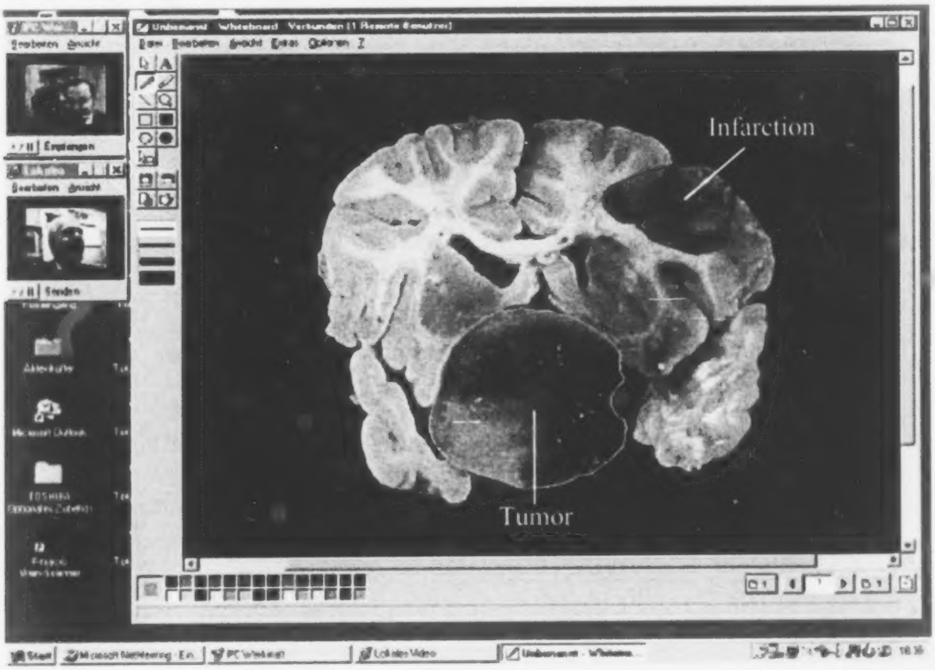

Figure 1: Teleconsultation using Whiteboard

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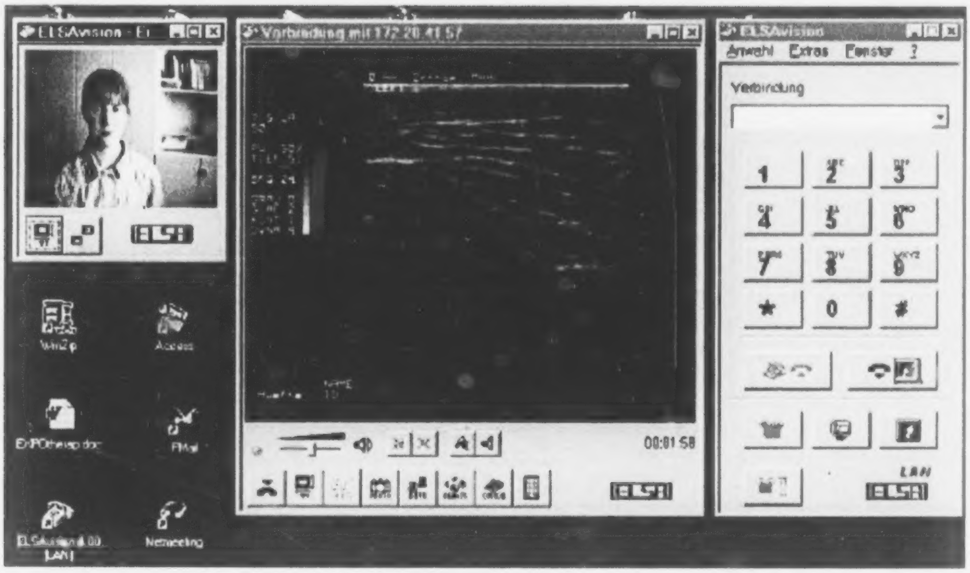

Figure 2: PC based video conference with remote ultrasound (life)

The main application of telematics in telepathology is the use of telemicroscopy. This will become more important since pathological expertise is not always available locally, and - in a worldwide sense - is extremely unevenly distributed. A first sucessful study at the Hannover Medical School was aimed to investigate the possibilities of teleneuropathology in a routine clinical setting [Matthies et al. 1998].

3. The G7 Global Healthcare Applications Project (GHAP)

The G7 is an informal forum of the seven major industrialized democracies. Ministers met in Brussels in 1995 and identified 11 pilot project areas for international co-operation, one is the GHAP. The G7 GHAP aims at improving quality and cost efficiency of healthcare delivery through telematics tools. It has ten sub-projects [www.gip.int]. Because this paper is only about education support possibilities we will only present the last two sub-projects

- Medical Image Reference Center (MEDIREC)
- IOA – International Online Academy (Special interactive TV and multimedia programs for professionals and public in dentistry and oral medicine).

4. The G7 GHAP Sub-Project MEDIREC

The objectives of this sub-project are to support clinical activities, contribute to medical education and training, and facilitate medical research. The proposed reference centers would include clinical and pathological images (still and moving) and typical, rare and difficult to diagnose cases. The G7 sub-project MEDIREC is co-ordinated by Japan [www.medirec.ncc.go.jp]. English language Medical Image Reference Centers are developed at the

- National Cancer Center Research Institute in Tokyo
  MEDIREC / Images of Cancer
- National Cardiovascular Center in Osaka

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MEDIREC / Images of Cardiovascular Diseases

- University of Regensburg
  MEDIREC / Images of Dermatology
- Hannover Medical School
  MEDIREC / Images of Neurological and Neuromuscular Diseases

Accessing such image databases via internet is possible. Data collection mechanisms, online publishing, and organization (including regional co-ordination centers), for example, have been proposed. A technical group will ensure interoperability with other image databases and will develop an information security management for file and image transfer.

In co-operation with the research centers specified above, a multilingual "MEDIREC / Images of Neurological and Neuromuscular Diseases" is being developed at the Hannover Medical School [Matthies et al. 1999a]. Efficient Web based database access to the MEDIREC at the Hannover Medical School is made possible via an Oracle Application Server that uses Java-based programs to answer requests, i.e. all authorized internet users may access the data using a standard web browser (e.g. Netscape, Microsoft Internet Explorer). An editorial board is responsible for the quality assurance of contents. The case examples for the MEDIREC in Hannover were prepared by the Institute of Neuropathology as well as the Medical Computing Center. The search masks and appropriate search results (fig. 3) can be displayed in several languages (WHO recommendation).

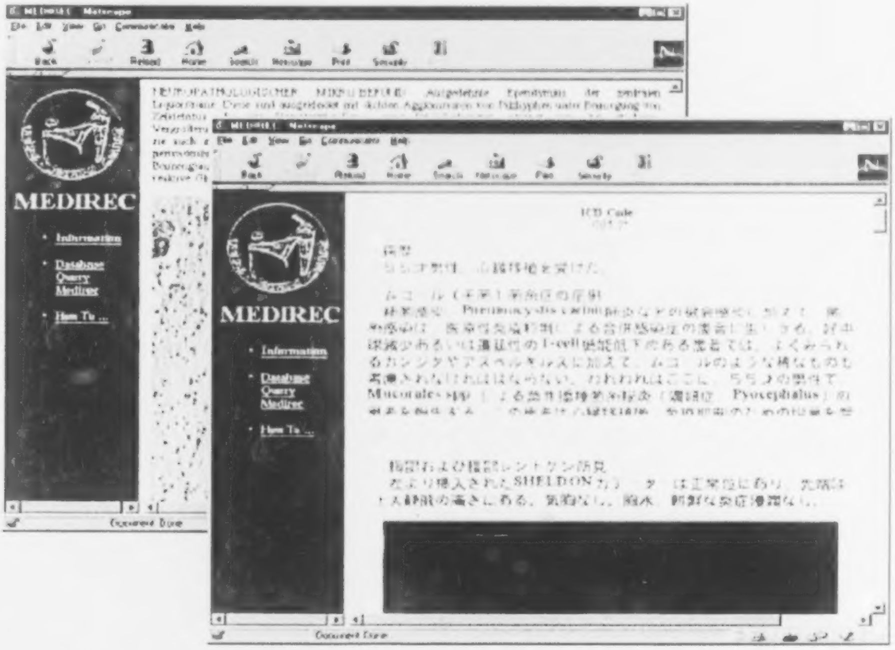

Figure 3: Query mask and query results in different languages

5. The G7 GHAP Sub-Project IOA

The expansion of the Internet will also lead to the formation of interdisciplinary "Global Education Networks". Such an exemplary network (fig. 5) will be realized in the G7 GHAP sub-project "MEDlive/IOA". The aim of the interactive "MEDlive" is to promote the international knowledge and information exchange in dentistry and oral medicine with telecommunication services, e.g. digital broadcast and internet services. The "International Online Academy of Dentistry and Oral Medicine" (IOA) is part of "MEDlive" and provides means for high quality, structured and certified education and continuing education.

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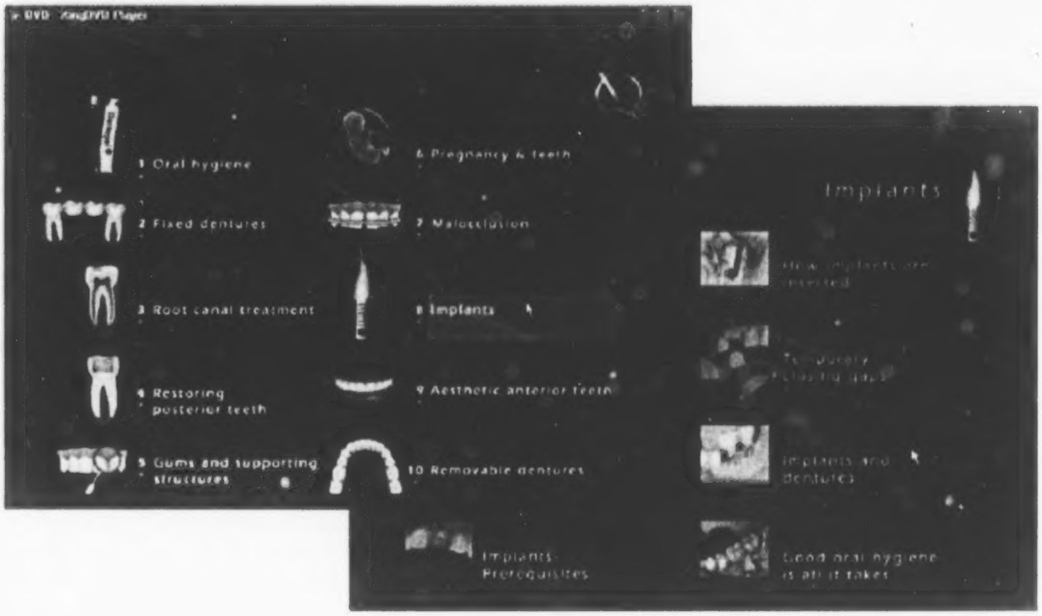
1 Oral hygiene
2 Fixed dentures
3 Root canal treatment
4 Restoring posterior teeth
5 Gums and supporting structures
6 Pregnancy & teeth
7 Malocclusion
8 Implants
9 Aesthetic anterior teeth
10 Removable dentures
Implants
How implants are inserted
Temporary closing gaps
Implants and dentures
Implants-Prerequisites
Good oral hygiene is all it takes

Figure 4: Video sequences for patient information

One day each week, video on-demand (fig. 4) is available as a test program via satellite television receivers (ASTRA) or television-based Web browsers. Project coordinator is the international Quintessence Publishing Group [quinline.globaldent.com] in Berlin. The aim of this engagement is to strengthen innovation, to assure the quality of content and to support the qualification and competence of the professionals on the road to the information society.

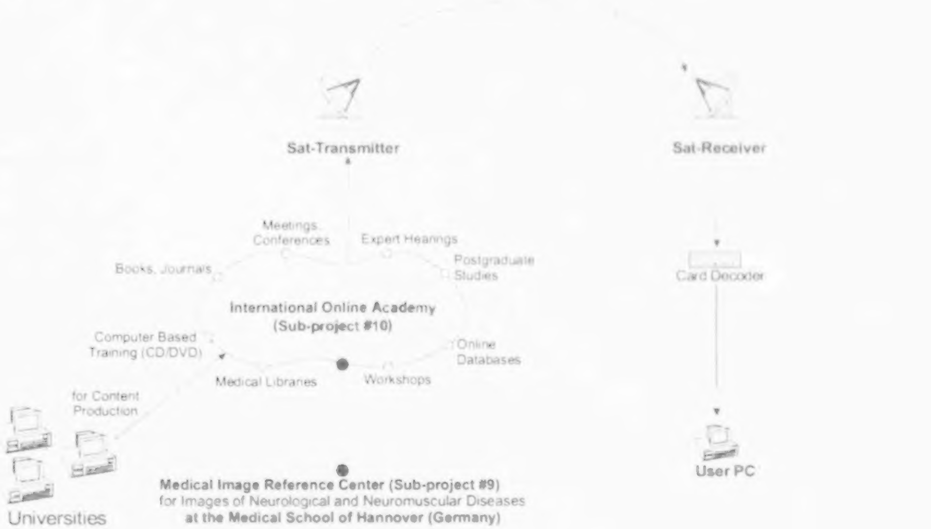
Sat-Transmitter
Sat-Receiver
Meetings, Conferences
Expert Hearings
Books, Journals
Postgraduate Studies
Card Decoder
International Online Academy (Sub-project #10)
Computer Based Training (CD/DVD)
Online Databases
Medical Libraries
Workshops
for Content Production
User PC
Medical Image Reference Center (Sub-project #9)
for Images of Neurological and Neuromuscular Diseases
at the Medical School of Hannover (Germany)
Universities

Figure 5: Link between MEDIREC and the G7 GHAP sub-project IOA

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6. Results

Telematics is a combination of telecommunications and informatics resulting in the transfer of information across distances. High rates of data transmission are necessary for the efficient use of multimedia technologies. Modern telematics infrastructures allow for instance

- flexible possibilities for distance learning
- world wide access to certified knowledge bases and digital image archives
- as well as simulations of and training for surgical procedures
- flexible training for the support of diagnosis and therapy by using visualization and simulation
- decision support for diagnostics and therapy
- creation of digital video libraries of clinical treatments.

The new information and communication systems open up new forms of learning and make it possible to combine classroom instruction/lecture and multimedia applications. New educational technologies and course contents will be required. First experiences have shown that in addition to medical lectures, specific offers for further education are required in dealing with electronical information sources. Learners' motivation will be improved by the access to multimedially supported teaching materials and contents. Problem-oriented learning will thus be possible and the quality of education will increase in general.

Multimedia technologies simplify the access to information from databases and electronical libraries. Renowned experts can give online support for healthcare professionals and patients. Knowledge and research results can nowadays be published and offered much quicker by the available telematics infrastructures. In contrast to printed books or video tapes, multimedia applications can permanently and easily be activated.

The theory and practice of education are undergoing dramatic changes. An innovative education resource for professionals and patients is the interactive use of multimedia applications in telecommunication networks. Video on-demand via satellite television receivers or television-based Web browsers will play an important role as effective user interfaces for access to broad range of knowledge and information resources. Learning is independent of time and location. The expansion of the internet will also lead to the formation of interdisciplinary "Global Education Networks" that focus on learning, not teaching. The challenge is not only for academic staff to change their work habits, but also for students to accept a changing concept of university education. Lifelong learning and adaptation of medical practice to new knowledge and new techniques will be even more important in the future.

7. References

[Matthies et al. 1997] Matthies, H.K., & Poliwoda, H., & Bob, K., & Link, H., & Porth, A.J. (1997). Multimedia Applications for Healthcare Professionals and Education. *R. Haux et al. (Eds.), Health and Medical Informatics Education. Abstract Vol., Newcastle (Australia)*, 96-97.

[Alpay et al. 1998] Alpay, L., & Murray, P. (1998). Challenges for delivering healthcare education through telematics. *Int. J. Med. Inform.* (50), 273-278.

[Richards et al. 1998] Richards, B., Colman, A.W., Hollingsworth, R.A. (1998). The current and future role of the internet in patient education. In: *Int. J. Med. Inform.* (50), 279-285.

[Matthies et al. 1998] Matthies, H.K., & v. Jan, U., & Porth, A.J., & Brandis, A., & Walter, G.F. (1998). Telediagnosis and Teleconsultation in Neuropathology. *Lemke, H.U. et al. (Eds.), Computer Assisted Radiology and Surgery*, Elsevier Science North Holland, Amsterdam, p. 464-467.

[www.multimedica.de] http://www.multimedica.de/

[www.po.com] http://www.po.com/

[www.vh.org] http://www.vh.org/

[www.gip.int] http://www.gip.int/g8

[www.medirec.ncc.go.jp] http://www.medirec.ncc.go.jp/

[Matthies et al. 1999a] Matthies, H.K., & Walter, G.F., & Stan, A.C., & Ammann, A., & von Jan, U., & Porth, A.J. (1999). The G7 GHAP sub-project "Medical Image Reference Center" at the Hannover Medical School. *H.U. Lemke et al. (Eds.), Computer Assisted Radiology and Surgery, 1999*, Elsevier Science B.V., Amsterdam, p. 591-595.

[quinline.globaldent.com] http://quinline.globaldent.com/

[Matthies et al. 1999b] Matthies, H.K, & Ammann, A., & Walter, G.F., & von Jan, U., & Porth, A.J. (1999). Innovative Multimedia-Anwendungen für Global Education Networks. *E. Baron (Ed.), Elektronische Medien in der wissenschaftlichen Weiterbildung, TU Braunschweig, 1999*, 193-203.

[Overhoff et al. 1999] Overhoff, H.M., & Lazovic, D., & v. Jan, U. (1999). Visualization of the newborns's hip joint using 3-D ultrasound and automatic image processing. *Proceedings of Medical Imaging 1999*, San Diego.

Digital Heritage and Cultural Content

Towards a European cultural information landscape

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Introduction to the 5th Framework Programme

The European Commission's 5th Framework Programme for Research and Technological Development, 1998-2002[1] is divided into five thematic and three horizontal programmes. The Information Society Technologies (IST) programme[2] is the largest of the thematic research and development programmes with a global budget of 3600 million Euro.

The main focus of the IST programme (1999 work programme) is on enhancing the user-friendliness of the information society: improving the accessibility, relevance and quality of public-services especially for the disabled and elderly; empowering citizens as employees, entrepreneurs and customer; facilitating creativity and access to learning; helping to develop a multi-lingual and multi-cultural information society; ensuring universally available access and the intuitiveness of next-generation interfaces; and encouraging design-for-all.

Multimedia content finds a central role in the IST programme. The objective here is to confirm Europe as a leading force in this field and enable it to realise the potential of its creativity and culture.

The Information Society Technologies Programme

The IST Programme brings together and extends the ACTS[3], Esprit[4] and Telematics Applications[5] programmes to provide a single and integrated programme that reflects the convergence of information processing, communications and media technologies. The 1999 IST work programme is mainly composed of action lines dedicated to four IST Key Actions, complementing each other in their overall objective to enhance the user-friendliness of the Information Society. The four Key Actions and their budgets for the 5-year programme are:

Key Action	Title	Budget (M euro)
I.	Systems and services for the citizen	646
II	New methods of work and electronic commerce	547
III.	Multimedia content and tools	564
IV	Essential technologies and infrastructures	1363

In this context the focus of this paper is on cultural heritage in Key Action III.[6]

Key Action III – Multimedia Content and Tools

This Key Action aims to improve the functionality, usability and acceptability of future information products and services, to enable linguistic and cultural diversity and contribute to the valorisation and

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[1] Detailed information to be found on:
'Cordis', the Community Research and Development Information Service at http://www.cordis.lu/
'Europa', the European Union's server at http://europa.eu.int/index-en.htm,
'ISPO', the EC Information Society Promotion Office at http://www.ispo.cec.be/

[2] by Decision No 182/1999/EC of the European Parliament and of the Council of 22 December 1998, a specific programme on a user-friendly information society was adopted by Council Decision No 99/168/EC of 25 January 1999 (Official Journal L 64, 12/03/1999 p. 20 - 39)

[3] see http://www.infowin.org/ACTS/

[4] see http://www.cordis.lu/esprit/home.html

[5] see http://www.cordis.lu/telematics/home.html

[6] see http://www.echo.lu/ist/ka3/

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exploitation of Europe's cultural patrimony, to stimulate creativity, and to enhance education and training systems for lifelong learning. Work covers new models, methods, technologies and systems for creating, processing, managing, networking, accessing and exploiting digital content, including audio-visual content. This Action Line integrates both applications-oriented research, focusing on publishing, audio-visual, culture, education and training and generic research in language and content technologies for all applications areas.

Digital heritage and cultural content is one of the five main areas for research and technological development and the aim is to expand the contribution of libraries, museums and archives to the emerging culture economy, and thus encompasses all aspects of economic, scientific and technological development. It is co-ordinated by the European Commission's Cultural Heritage Applications unit, DG XIII-E2[7], in Luxembourg.

A View of the Future

What is emerging as a focus for the future is to help create a European cultural information landscape by encouraging cultural memory organisations to participate in R&D actions providing innovative prototype networked services for both professional users and citizens. This future information landscape should be easy to identify, easy to access, and easy to navigate and should be extended to also encompass Europe's scientific and industrial heritage.

Equally tomorrow's cultural content will be produced by generating new forms of digital media. What this cultural content will be, and how it will be created, managed, distributed and preserved remains uncertain and a fertile ground for future research and experimentation.

The key participants in future cultural heritage projects must be Europe's memory institutions, both public and private, with a particular focus on new alliances with technical and content-related partners.

Research Priorities[8]

In translating this embryonic vision of the future three research priorities have been identified, namely:

- Ensuring integrated access to collections and materials held in libraries, museums and archives
- Improving the operational efficiency of large-scale content holdings by means of powerful interfacing and management techniques
- Preserving and accessing multimedia content of various types, including electronic materials and surrogates of physical objects.

The Annual Work Programmes

The IST programme is a flexible framework where focus is built within distinctive annual work plans. For the 1999 work plan[9], the research priorities are taken up in two main action lines:

Key Action III, Action Line 2.3, Access to scientific and cultural heritage - call for proposals was launched on 19 March 1999, closed on 16 June 1999

Key Action III, Action Line 2.4, Digital preservation of cultural heritage - call for proposals scheduled for 15 September 1999.

Action Line III.2.4 Digital preservation of cultural heritage

Objective: To address new ways of representing, analysing, manipulating and managing different kinds of digital cultural objects from different media sources, with special attention given to surrogates of fragile physical objects. The work should focus on the sustainable development of valuable digital repositories in Europe's libraries, museums and archives. It should address the technical and organisational problems surrounding the viability of scaleable digital repositories, e.g. through test-bed creation for: long-term preservation and content management in distributed heterogeneous collections (e.g. provenance, authenticity, identification and links). Particular attention should be paid to long-term accessibility, both by citizens and for scientific analysis, and to quality, affordability and acceptability.

For more information and details on contacts, have a look at the DigiCult web site at
http://www.echo.lu/digicult/home.html

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[7] see http://www.echo.lu/digicult/home.html

[8] see background material/publications on metadata, digitalisation and preservation issues at http://www.echo.lu/digicult/en/study.html

[9] see http://www.cordis.lu/ist/wp.htm (to download 1999 work programme)

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Client Design for Service Centric Architectures

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Abstract: Next generation computing clients and appliances are components of systems and applications that are service centric, and the potential for economic growth of e-commerce and e-services that use such systems is immense. This paper will address the design of next generation clients considering new constraints and opportunities that result from this shift towards a service centric architecture. Designers need to consider factors that cut across both mobile and fixed client design and include aspects of networking, new hardware, data types, and operating systems. From a technology provider's viewpoint, the definition of a system or application is now more abstract, but also provides opportunities by creating ways to benefit both technology users and providers. The paper will also illustrate how some of these points are being addressed through work in next generation clients taking place at Hewlett Packard Laboratories, Palo Alto.

1. Introduction

Next generation computing architectures are increasingly service centric. This is characterized by a shift away from a box centric approach to system design towards ones that are specifically targeted to exploit network based goods and services. Such architectures are comprised of more loosely defined elements, largely dependant on and coupled together through communication networks. Evidence is strong that the growth of the internet, and the current expansion of on line resources and services lumped under the industry term e-commerce are responsible for this shift. In 1998 the United States generated $301 billion USD in revenue from e-commerce, and it is predicted that by the year 2006 almost half of the work force in the United States will be employed by industries that produce information technology or are intensive users of it [Page 1999]. Coupled with this are new alternatives to the PC for how customers will consume and interact with e-commerce. As a means to access web based information, the PC will drop from 94% now to 64% by the year 2002. Information appliances are predicted to exceed PC sales by the year 2001 and by 2002 it is predicted that 56% of homes in the U.S. will be connected to the internet [Business Week 1999]. Other non-computer devices such as entertainment systems and classic home appliances will be connected to the internet to allow customers to obtain new types of support services further illustrate this shift. The box, or client device is just a means to exploit e-commerce. As the revenue generator, e-commerce becomes the real consumable.

The problem for client and system designers is how to design a next generation client. What makes this important is the realization that customers are now paying for services in a very literal sense. They want to consume the goods they select, and interact with the services they desire, and they have individual expectations for how these appear and function. Designers need to address how the definition of an application is changed when, from the user's viewpoint, the system focuses more on the services and less on the clients. New technology considerations will enter into the client design process for both mobile and fixed internet appliances and applications. Combined with this are new constraints, benefits and opportunities that can add new ways of generating revenue for technology providers. This paper address new technology considerations that should be made in the design of next generation clients used in service centric architectures.

2. Application Definition

To understand the impact of a service centric architecture on client design, it is useful to consider how applications are defined from the user's and technologist's viewpoints. From the technologist's viewpoint, a service based application is an aggregate of four abstractions; clients, transport, servers and services. Services represent the revenue

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generating consumable, and can be associated with functionality such as information, productivity, entertainment and communication, and supporting resources such as electronic payment, user authentication and agent services. Servers are the physical entities that host the services. Transport refers to the means by which servers present services to clients, and can be realized in a variety of wired and wireless forms. The clients are the physical entities that users interact with to consume services. In a box centric architecture, all of these abstractions can be represented in a single device, for example a PDA with a data server process communicating using an inter-process communication protocol to a client process that can display information on a screen. In a service centric architecture, the abstractions are physically distributed, sometimes over large distances, and are linked by a data network. The aggregate that makes up an application can consist of multiple elements of each abstraction. An application may require multiple services from several vendors connected by different physical transport mechanisms. An application may require the participation of multiple individual clients, for example a future home entertainment system consisting of networked speakers, tuners, storage and displays. An application can be spatially large scale, such as an energy utilization service for an entire building deploying potentially hundreds of clients associated with lighting, heating, cooling and human presence detection. The grouping of all the components into an application can happen statically or dynamically, even allowing an application to add or remove components during utilization. In both cases application components need the ability to discover other components to form a complete aggregate. In some cases, multiple choices of equivalent functionality can be discovered, and a mechanism used to select one over others, for example user preference, cost, or service quality.

From the user's viewpoint, an application can only consist of two elements; the user, and the intended function, for example to listen to music, or look at a picture. Any logistical functions outside of these two elements such as connecting , configuring, or initializing something often are unanticipated requirements of the application that does nothing to enhance the value of the intended function from the user's point of view. If sufficient amounts of these logistical extras exist, their impact can outweigh the expected benefit of the anticipated function, resulting in the customer rejecting the technology. Works such as [Landauer 1996] discuss related issues in traditional computer applications. These issues apply equally to service centric applications, possibly more so given the potentially unbounded nature of internet services with respect to the components. New client technology must conceal logistical details from the user as much as practical. In addition, for a given application, different users will have internalized different expectations for the intended function, resulting in the need to personalize, or accommodate individual preferences in an application.

3. Design Aspects of Next Generation Clients

In work taking place in next generation client design for internet applications at Hewlett Packard Laboratories in Palo Alto, shifting technology considerations resulting from the need to meet the new requirements of service centric applications have been influential in client design. These considerations apply to both fixed and mobile clients, and affect both hardware and software. Among the most important that will be discussed are client power considerations, the effect of shrinking client size, internetworking, operating systems, dynamic persona and user privacy.

3.1 Client Power

In many portable devices, the biggest contributors to weight are batteries, housings and printed circuit boards [Funk 1999]. To design devices that are unconsciously portable requires a strong attention to power consumption in order to maximize battery life for a given weight. From the client designers view, there are three ways to address minimizing power consumption. They are to design and deploy low power circuits at the device and gate level, to design into the device support for dynamic power management, and to use algorithmic power optimization. Designing and using low power circuits is already something many designers do as it is desirable in most areas of circuit design. It is driven by environmental concerns as well as by practical necessities such as the maximum voltage ratings of small lithography processes, and the desire to balance battery size and weight with lifetime. To exploit low power circuits, designs from the start should use power as a metric reflected in specified performance. For example, processor requirements should be expressed in *MIPS/watt*, and memory systems should be expressed in *bytes/sec/watt*. When combined with cost, these metrics can become striking.

Dynamic power management is also an area that many designers take into consideration by designing entire subsystems that can be powered down when not needed. Software working with such hardware through a well defined interface is a good way to provide a coherent, system integrated solution for controlling several separate subsystems. Operating system support for ACPI is a good example of this [Intel 1996].

With respect to next generation clients, algorithmic power optimization is a new tool methodology. In this approach, a cycle accurate model of the entire client is constructed, including models for all memory, I/O, processor, cache and other subsections. A simulator is configured to use these models and provide in addition to circuit behavior a cycle by cycle picture of where energy is expended. We have used this technique [Simunic 1999] to co-optimize the performance of prototype hardware and algorithms, in this case for MPEG image decompression, by exploring many different hardware and software architectures and finding the one that give the best performance expressed in decompressed *frames/sec/watt*. This technique is especially suited to clients for service centric architectures because in many cases such clients are designed for a specific application, such as multimedia or communication, making such hardware/software/power co-optimization very practical. For the user, this translates into *amount of service/watt*, which is expected to be maximized.

3.2 Effect of Client Size

Many emerging services will be targeted towards mobile, wearable and other clients where the physical size of such clients are expected to be very small. For example, size and weight are drivers in the Japanese handset market [Funk 1999] where devices weighing 68 to 85 grams are the current state of the art. While such size trends provide users with clients that are increasingly unconsciously portable, designers need to be concerned with maintaining or increasing functionality. Messaging services in Japan represent 40% of calls on PHS handsets, and other non-voice services such as restaurant locating, horoscope, sports and others are becoming popular. Services exploiting speech and audio are appearing everywhere, and video will follow. As streaming media services and higher bandwidth networks become available, allowing the proliferation of multimedia applications, designers will have to insure that although the size of mobile clients remain small, the interface to the user remains 'large'. The trend toward smaller mobile client size produces non-obvious new design considerations.

One of the most prominent is support for streaming audio and video. To support applications that require high resolution displays of 800x600 pixels and higher and still maintain small size, designers will have to implement emerging personal display technology such as foldable and wearable microdisplays. For such wearable displays, designs will have to take into account details such as field of view, vertical position, transparency, level of immersion and others [Gaddis 1999]. The display technology will determine the interface, which can be difficult to design and integrate while keeping power consumption reasonable. For example, a microdisplay having an interface utilizing sequential color loading will require a pixel drive rate triple the usual parallel RGB pixel rate. Binocular, stereo visual data will add more to this. Another consideration is interconnect. When a wearable microdisplay is combined with headphones, controlling the number of physical interconnection wires becomes difficult unless the use of high speed bit serial driver technology and data packet protocols that can contain both the video and audio data are considered. Interconnect of this kind will also be necessary as common devices such as wristwatches, wallets and eyeglasses increasingly become components of wearable clients distributed over the user. Designers need to establish standards for the physical interconnect and the data protocols that will go over them.

3.3 Communication and Internetworking

As with personal displays, the availability of streaming media will require designers to focus on support for communication protocols, and data formats. Obvious considerations include hardware to support chosen physical interconnect and data formats such as compression standards. Design decisions that are not obvious, especially in designs that will exploit wireless communication, are how to provide robustness to data errors and loss and how to accommodate data streams that are intermittent in nature, especially in wide area and electrically noisy environments. The ability of clients to handle broadcast and multicast data streams may require designs that can support transcoding of audio and video data to accommodate differing hardware capabilities. This uses special coding methods that can require hardware support especially for high resolutions and frame rates. Commonality at the physical layer in wireless environments may never be achieved, so internetworking with other devices that may be required to form a complete application presents a design challenge. The technology associated with wireless access points will also influence the choice of the physical interconnect. For them to be ubiquitous, access points must be very inexpensive, preferably cheaper than the cost to install them, and require no maintenance. For example, can access points be self powered?

Power requirements of radio subsystems will remain a problem for wide area systems where watts of transmitting power at times are required. For local area and home systems, radio subsystems need to migrate toward lower voltage, lower power designs. The design of the application and how it uses the communication channel also affects the hardware design. For example, applications that use mobile clients should design access points to beacon in search of clients to connect to, rather than requiring the battery operated client to beacon instead.

Designers will have to balance cost, power and quality of service. Meeting quality of service requirements is an active subject in the compression and networking communities. The client designer must still balance latency, and synchronization with a required quality of service for an application. This will be reflected in the processor, memory architecture and I/O chosen with an associated influence on power consumption. In [Qu 1999] a system synthesis methodology for multimedia applications is shown that attempts to minimize silicon area, including buffer memory requirements to support a desired quality of service. The synthesis system will identify a best choice of processor and caches, and once fixed will determine a task schedule with minimum storage requirements. When combined with power optimization, the designer can explore the cost, power and quality of service tradeoffs and converge on an optimal solution.

3.4 New Operating Systems

Clients used in service centric applications will be designed to support operating systems that focus on different functionality than the ones typically used now in PCs, PDAs and most embedded applications. As is the case now, no single operating system can be reasonably expected to satisfy the needs of all application spaces. Service centric spaces will emphasize support for distributed applications, and the necessary provisions for safety, security and communications that go with them. Aggressive power management is also a requirement, both from supporting dynamic power management, and by employing algorithmic power optimization on the operating system itself. In addition to the applications being distributed, new applications will emerge that use multiple client devices, which themselves are distributed. In this case there will be a need to coordinate the individual devices in an application dependant way, both with respect to individual functionality and as an aggregate. Finally the footprint of these operating systems should be kept as small as possible to allow the client designer another means to control cost , power and complexity. An example of an operating system that supports many of these goals is found in [Gabber 1999].

An experimental framework for organizing, constructing and deploying complex software called *Component OS* developed at Hewlett Packard Laboratories addresses these issues. Component OS creates systems that are collections of *component services*. Component services are code and data generated by the Component OS system that encapsulate a set of resources or functionality. These resources can be anything describable to the Component OS system, such as a hardware subsystem in a client like a communication interface, a software functional block like an IPC mechanism, or an entire client device like a speaker. The component services provide a mechanism for the resources to be structured and used. The integration of the components into a system is done by an abstraction called a *service interchange* which is responsible for directing operation requests to the appropriate place in the service code and for enforcing any protection requirements. There is no pre-determined list of component services that must be used when constructing a system. This means that a resulting operating system and program environment constructed by Component OS is precisely tailored to the specific resources that can be provided by a client device, and can be constructed and deployed on an application by application basis. By using a detailed model of the client hardware, algorithmic power optimization can be exploited to produce component services that are also optimal with respect to power consumption.

3.5 Dynamic Persona

The ability of a device to appear or function differently in a fixed application depending on who, where and under what conditions the application is being used is termed *Dynamic Persona*. People who purchase a client device, for example a digital camera, have a good idea of the desired application they want it to perform, in this case to take pictures. Different people will have very different ideas of exactly how they want it to perform, for example how the camera is configured, how the pictures should appear, and how they should be processed, stored and shared. This makes the ability to personalize a device or application very desirable from a technology provider's viewpoint. As applications become service centric, the ways that the application can be personalized potentially becomes very large. To support dynamic persona, a client device needs the ability to determine who is using the device, where it is being used, and the environment it is being used in. Environment means data such as whether or not a device is still in a user's possession, if the user is moving or stationary, if moving is the user in a vehicle or walking, is the user alone or with others, is it light or dark, wet or dry, hot or cold and so forth. To do this, a client needs to be designed with sensor technology. Biometric sensors are used to determine user identity. GPS, specialized beacons or information about the access point or base station a client is connected to is used to determine a user's location. Environment data is obtained by using a variety of sensors to detect such things as sound, images, motion, position, humidity, electromagnetic fields and temperature. An example of such a client platform currently used at Hewlett Packard Laboratories that is capable of supporting dynamic persona is described in [Maguire 1998]. Sensors can be deployed and dynamic persona exploited in both fixed and mobile devices.

In addition to allowing a device and application to be personalized, knowing who, where and in what environment a device is being used offers other advantages. Devices can be self configuring or filter data based on location and environment. By knowing a user's identity passwords and PINs are unnecessary. New services can be dynamically offered to the user opportunistically based on surroundings and needs. Devices can reveal who is using them and how, resulting in new ways to support applications and products. New spaces for services are created in areas such as authentication and security, monitoring, agent correlation, business resource management, new user interfaces and marketing. One current example can be seen in [ISO 1999] where a proposed metadata standard for digital pictures can make use of such sensor data. The advantages to consumers are that now applications are tuned to match the expectations of each user, and that many of the logistical tasks required to use a device or application, such as passwords, connectivity or configuration no longer need be performed by the user. For the technology provider there are many advantages in new service and application opportunities.

3.6 Security and Privacy

Designers will need to accommodate the requirement that transactions between client devices and services be secure. Algorithms and possibly special hardware to facilitate encryption of all data communications are needed to protect both the user and the service provider. For clients that do not exhibit dynamic persona, and contain user data, the design should allow for the data to be rendered useless or unintelligible should the device be lost. The deployment of sensors to create user, location and environment aware clients creates new problems of privacy that go beyond those that can be solved by encryption. There is a significant amount of public confusion over the issue, and this will challenge the client designer because technology alone will not resolve the issue, and will require aspects of sociology, legislation and litigation.

From the designers viewpoint, the need to accommodate user privacy will expand the definition of a trusted system. Not only is it trusted to provide secure and authentic data and resources, but it is also one that protects privacy interests. With respect to applications on next generation service centric architectures, privacy issues will likely be resolved application by application. The user must be allowed to decide the tradeoff between the perceived benefit of an application and the perceived privacy risk. Client designs must support the user's right to dynamically choose from no protection of privacy to full protection even for the same application used under different conditions. This is consistent with the idea of dynamic persona in that it allows an application to also behave with respect to privacy according to the user's expectations. Dynamic persona may be of use in other aspects as well, for example by possibly combining elements of augmented reality with biometrics thus allowing a single individual to have multiple logical identities, each one different for each different application. Privacy with respect to technology is a rapidly expanding field of study, and much more work will be needed.

4. Conclusions

The trend favoring the growing number of goods and services appearing from networked sources illustrates the shift towards future computing architectures that are service centric. Future clients used in these architectures become components of the system and are used in potentially new roles. The shift towards server centric architectures introduces new technology considerations in client design that the designer needs to account for. Areas where these new considerations particularly stand out are in design for low power including algorithmic power optimization, the effect of shrinking size on other parts of the client design and new requirements introduced in connectivity and internetworking, especially those that are the result of the emergence of digital multimedia services. New operating systems that focuses on the requirements of distributed services and clients, the use of sensor technology to personalize both services and devices and allow for dynamic persona, security and privacy issues are also new technologies for the designer to consider. The benefits of these emerging service centric architectures and the next generation clients that support them are shared by the technology providers and the users. For technology providers, the benefits are to enable new businesses, services, marketing and support that will be major revenue generators. For users, the benefits are that applications will be personalized, and will more closely provide the functionality the user expects while removing from the user many of the logistical concerns of using the application. The future will involve the evolution of new supporting services and standards, such as those for electronic payment, encryption and authentication, and services that support dynamic persona. These will in turn present further new technology requirements for client designers. Support for privacy protection is one such area that will drive designs of the future.

5. References

[Business Week 1999] Beyond the PC, *Business Week*, March 8, 1999, 78-88

[Funk 1999] Funk, J. (1999). Voice and Multimedia Application Requirements for Future Wearable Computers and Third-generation Handsets. *ATIP Workshop on Wearable Computing, 1999,* Asian Technology Information Program, Tokyo, Japan

[Gabber 1999] Gabber, E., Small, S. Bruno, J., Brustoloni, J. & Silberschatz, A. (1999). The Pebble Component-Based Operating System. *Proceedings of the 1999 USENIX Annual Technical Conference*, Advanced Computing Systems Association, Berkeley, CA

[Gaddis 1999] Gaddis, N.B. (1999). Personal Displays for Wearable Computing. *International Conference on Wearable Computing, 1999,* Xybernaut GmbH, Boblingen, Germany

[Intel 1996] Intel, Microsoft and Toshiba (1996). *Advanced Confiuration and Power Interace Specification.* <http://www.intel.com/ial/powermgm/specs.html>

[ISO 1999, rnational Organization for Standardization, Technical Committee 42 - Photography, ISO/DIS 12234-1 and 12234-2 May 1999 <http://www.pima.net/standards/iso/tc42/WG18.htm>

[Landauer 1996] Landauer, T. K. (1996). *The Trouble with Computers.* Cambridge, MA: MIT Press

[Maguire 1998] Maguire, G.Q. *SmartBadge III.* Spring 1998 <http://www.it.kth.se/edu/gru/Fingerinfo/telesys.finger/Mobile.VT98/badge3.html >

[Page 1999] Page, S. (1999). E-world fuels U.S. Economy, *USA Today*, June 22, 1999 1

[Qu 1999] Qu, G., Mesarina, M., & Potkonjak, M. (1999). System Synthesis of Synchronous Multimedia Applications, *International Symposium on System Synthesis, 1999,* IEEE Computer Society and ACM SIGDA, San Jose, CA. Accepted for publication.

[Simunic 1999] Simunic, T., Benini, L., & De Micheli, G. (1999). Cycle-Accurate Simulation of Energy Consumption in Embedded Systems. *Proceedings of the 36th Design Automation Conference, 1999.* The Association for Computing Machinery, New York, NY. 867-872

Full Papers

Integrating Multimedia Techniques into CS Pedagogy

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Abstract: Through its grants, the National Science Foundation sponsors workshops that inform faculty of current topics in Computer Science. Such a workshop, entitled, "Developing Multimedia-based Interactive Laboratory Modules for Computer Science", was given July 27 - August 6, 1998, at Illinois State University in Normal, Illinois. Each participant was expected to design and implement a small part of a laboratory module. This paper describes what some of the faculty members who participated in the workshop have done with the knowledge obtained from the workshop.

1. Introduction

The five authors met at an 11-day multimedia workshop sponsored by the National Science Foundation and hosted by Dr. Dean Sanders and Dr. Janet Hartman of the Computer Science Department at Illinois State University in Normal, during summer of 1998. After participating in intensive all day classes together, we spent the evenings in the multimedia lab applying what we learned each day. We also ate breakfast, lunch and dinner together, and checked out Normal, Illinois together during the weekend, all the time exchanging ideas, arguing and laughing together. Having shared a wonderful learning experience, we made a pact to meet again to share the results our attempts to apply our newly acquired knowledge to courses that we teach in and to new course development. Devoting 100 percent of our time to discover what multimedia [Vaughan 1996] was all about with interested faculty was an ideal way to learn about multimedia [Walsh 1995].

2. Ahmad Nasri

Recursive Subdivision is receiving a great deal of attention in Computer Graphics for modeling and animation. It is also becoming an important component in courses such as computer-aided geometric design (CAGD). The nature and the diversity of these techniques require the development of illustrative tools that help students to digest the ideas, interactively manipulate shapes and even explore new techniques. Such a technique is defined by a set of rules that takes in a configuration and generates another subdivided one. Inspired by the NSF multimedia workshop, we have begun implementing a multimedia course in computer-aided geometric design, which we expect to be an essential tool in our CAGD course. Students will be able to use the system in various ways such as:

- Visualize how a set of rules leads to a limit curve or a surface.
- Exploring ways to alter the subsequent subdivided configurations to deform the limiting shape.
- Interrogating subdivision curves or surfaces such as surface/surface intersection.
- Visualize how to compute moments such as volumes, center of mass and inertia tensors for physically based animation. Several tools are developed using Visual C++ which are added to the Multimedia parts for interactive use.

3. Anne-Louise Radimsky

Many students have difficulty with the abstract concepts associated with data structures. I have always believed that concrete analogies and visualization of the algorithms involved would help those students understand better the ideas presented. In particular, computer animation is a powerful tool to display in a clear manner the effects of the execution of a piece of code on the representation of a structure. Several attempts at having graduate students develop such animations have met with mixed results.

During the workshop we were presented with two powerful systems designed to produce animation: Asymetrix Toolbook and Macromedia Director. They use different paradigms. The first relies on an approach similar to that of Microsoft Powerpoint., the second is based on the concept of "actors" which can be brought into a score at different times to create a scene in a play. I chose ToolBook, both because it seemed better suited for the text-based animation I had in mind, and also because it was available on my campus.

I first created a prototype using Powerpoint. This allowed me to determine the screens sequence and the visual components needed. It proved very useful. It was easy to produce and allowed the instructors to offer suggestions on the flow of the presentation and the screens design. My goal was to illustrate the insertion of a new element in a linked list implemented with simulated pointers (i.e. using an array of nodes). As the code is executed the changes to the array are displayed.

I have added some additional operations and, with the precious help of a member of the campus media department, greatly improved the presentation. Although this individual does not have the background required to understand the substance of the algorithm, his input and experience has been invaluable in improving the appearance of the system.

My plans are to continue to develop modules for additional operations and other list representations. Ultimately, I plan to provide this material on the web for students to use in self-paced mode. Judging by the number of sites providing various kinds of multi-media resources for teaching computer science there is clearly a strong interest in many quarters for such educational material. The California State University system is also strongly encouraging the use of web-based multimedia systems to support delivery of instruction.

4. Bon K. Sy

In the last few years we have explored the possibility of employing multi-media technology to enhance teaching and learning science and technology. This is a result of the NSF Scientific Visualization workshop (1997) in Atlanta, Georgia, and the NSF Multimedia technology workshop (1998) in Bloomington/Normal, Illinois. Our focus is on using multi-media to support instructional activities. Learning based on multi-sensory channels will be an integral part of our curriculum in training students majoring in computer science and related science disciplines.

There are three major components of our project on employing multi-media technology to enhance science education. The first component is the development of a computer controlled instrumentation laboratory and curriculum enhancement under the support of a current NSF ILI grant. The focus is to introduce students with computer based instrumentation for automatic data acquisition and data analysis; e.g., using temperature and humidity sensors to collect weather data for predicting possible thunderstorm. Recently, a new course CS86 has been developed as a vehicle to implement the curriculum. Our goal is to use this vehicle to attract students to major in science and technology, as well as to retain them in the disciplines. This new course was offered the first time in the fall semester of 1998. Our initial success has led to the permission by the administration to offer the course again this coming fall semester.

The second component is our research on the learning methodologies for machine and human learners. We have investigated a pattern-based learning principle that integrates the rigor of mathematical based scientific analysis with abstract visualization of difficult science concepts. We are in the process of harnessing and integrating decision support tools developed from research laboratories with commercially available analytical tools. One specific component is the integration of a Bayesian decision support system developed by us using ActiveX technology with existing analytical tool S-PLUS.

Another component of the project is to create a scientific data depository based on Oracle server as the back-end, and to integrate it with the integrated analytical tools just mentioned. Further details can be found in another paper to be published in this conference proceeding [Sy, B.1999]. Several sets of courseware that implement the pattern-based learning principle have already been developed and will be demonstrated during the conference presentation.

The third component is the activities related to the two workshops mentioned earlier. The focus is to identify multi-media tools that will be effective for developing courseware for educational purposes, as well as Computer Based Training (CBT) packages, to support and enhance learning. Specific activities will include the development of CBT packages to illustrate the use of complex software systems effectively. A sample example developed in the NSF Multi-media technology workshop is available on the web via "http://tweety.geol.qc.edu/nsf/courseware/". We intend to use this component of the project as a vehicle to produce and prepare (electronic) documents for not only local distribution, but also wide dissemination over the Internet to other parties who may be interested in our projects.

Now we shall present our experience on the development of web deployable courseware for this project. The targeted audience of the courseware is the students of two courses: (a) Science Problem Solving using Computing Tools (CS86) --- a course for freshman and sophomore students in general science, and (b) Algorithms based on Probability Methods (CS762) --- a course for undergraduate senior and graduate students in Computer Science.

The development of web deployable courseware consists of three tasks: (a) content material development, (b) media presentation and application feature, and (c) dissemination. Currently we focus on developing courseware for content materials that involve mathematically oriented concepts, in particular, those concepts that are difficult to our students; e.g., system equations for projectile motion in CS86, or the computational geometry of hyper-tetrahedron that encompasses all possible discrete multi-variant probability models in CS762. An important consideration of our courseware development is the visualization feature for a student to explore visually the mathematical structure behind a difficult concept. Another important consideration is the transportability of the courseware for a wide dissemination beyond our local community.

In this project, the pedagogy behind the content material development is an integral part. Many science concepts are mathematically oriented; e.g., the fundamental principle in electromagnetic is stated in terms of Maxwell's equation [Paul et al. 1997], the behavior of an electron can be stated in terms of Dirac equation [Hawking 1993]. As a result, science concepts are often taught like mathematics, but with attached meanings as they are related to our physical reality. Yet for many students the details of mathematics, as opposed to the structure of a concept behind the mathematics, could be a distraction that hinders the comprehension of the concept. Thus the ability to visualize and formulate a structure mentally from the mathematical details is an important skill to understand many science concepts that are mathematically oriented.

As noted from our students, math and science understanding are often related to the ability to visualize. This often left out many students to engage in science and technology. Fortunately, new and better computer tools have become available for scientific computing and are widely used in industry [Johnson 1997], [Oppenheimer 1997]. Improvements are now at the point where these tools could be integrated into the undergraduate science curriculum. These new tools may help to ease that gap by being an aid to that visualization.

These new tools come with electronic books that provide 'live' formulas where the data can be manipulated, graphed, or even animated [Spiegel et al. 1998], [Nelson et al. 1995] , and [Spiegel et al. 1989]. This is not just a textbook in an electronic form, but a new media providing new modalities for learning. Integrating new modalities with traditional text-based modality is particularly well suited for the pattern-based learning approach mentioned earlier [Sy, B.1999], which is a significant and integral part of our project on enhancing science and technology education. Using these new modalities, students can apply the conceptual learning tool --- pattern-based learning --- to gain a greater insight into visual reasoning behind the numbers and their mathematical relationship. By increasing the number of ways a student can learn scientific formulas, we can make science education more inclusive.

Many famous scientific publishers are producing learning materials in this new media. For example, Schaum's Interactive Outline Series based on Mathcad allows students to run the outlines electronically [Edminister 1994]. Students can access formulas with the click of their mouse, and interact with the formulas while grasping the subject matter. In our project, we have developed an array of courseware using Mathcad, as well as courseware based on ActiveX technology.

Each courseware is web accessible in the Internet with the Mathcad/MathConnex plug-in that takes the advantage of OLE automation technology. Each courseware being developed is focused on a special topic/concept in either CS86 or CS762 mentioned earlier. A set of courseware already developed for our CS86 and CS762 can be found in our web site http://tweety.geol.qc.edu/nsf/demo. The details for accessing the courseware will be detailed during the conference presentation.

5. Richard Jou

My "Computer Graphics" class for the Spring Semester of 99 includes a multimedia project using some of the software tools that I was exposed to during the summer NSF multimedia workshop. This is a junior/senior class covering mainly geometric modeling and algorithm designs of the basic principle of computer graphics. The basic software tools used for this class include C, C++ and a graphics library.

I am also designing Web-based courses where most of the class materials, homework assignments, and project assignment are uploaded onto our Web server, where students can access them through a Web browsers and submit their homework through E-mail. Each semester allows me to re-evaluate my course content available on the Web through student successes/failures and feedback . I am currently updating my Web based teaching materials to improve them.

6. Sandra Honda Adams

At the workshop I was pleasantly surprised to see how easy it was to prepare multimedia slides using Powerpoint 98. We are presenting workshops in Powerpoint to the faculty here to show them how interactive, non-linear presentations can be created using this authoring tool. Buttons that trigger video, sound or music, and navigation to other slides can easily be incorporated into Powerpoint slides used for lectures. Director workshops will also be given to faculty at our institution and for area high school faculty. Five new projections units have been added to classrooms to help encourage the use of technology in the classroom.

The students are able to create multimedia animations [Gross et al. 1999] using Macromedia Director's embedded text and paint programs, and embellished their work with recorded sounds. Thanks to the NSF workshop I have added segments on video, photo [Sawyer & Pronk 1997] and audio capture [Seaman & Cline 1996] and manipulation to these classes by including additional segments on Photoshop [Quinn et al. 1997], CoolEdit and scanning to our existing multimedia courses. The video component will allow the student to modify a portion of a personal VCR tape, creating short segments to include in their multimedia productions. The scanning component will allow students to scan photographs [Aaland 1996] for PhotoShop manipulations. CoolEdit will allow students to record and manipulate speech and music. The added material will delight students as they deploy their Director movies for the web by preparing their movies for streaming shockwave. [Yeaman & Dawson 1996]

I have been spending my time learning other software to develop new classes for our non-major courses and for our Info Tech major. We have many employers who are calling for Web and multimedia developers and designers [Fromm 1995]. Their requirements are constantly growing and students wanting these positions need to know other Web based software. We have developed and are constantly re-designing our Web Design course [Siegel 1997], [Lemay 1997]. We are also planning to add Authorware [Roberts 1997], Flash [Plant 1998], and Dreamweaver to our Multimedia and Web Design Courses.

We are experiencing an increase in the number of students enrolling in our new Information Technology MS program. Graduates of other programs are also interested in learning more about Information Technology. They are very interested in joining startup companies that are developing e-commerce or companies that are developing or maintaining Internet or Intranet sites.

7. Conclusions

Each faculty member has utilized some of the tools that were presented and have implemented them in a variety of ways in their courses and curriculum. The NSF multimedia workshop was an excellent opportunity to learn something new and meet others who were curious about learning and using interactive multimedia and web technology in the classroom.

8. References

[Aaland 1996] Aaland, Mikkel. (1996). *Still Images in Multimedia.* Hyden Books, IN.

[Edminister 1994] Edminister, Joseph A. (1994). *Schaum's Interactive Outline Series: Electromagnetics.* McGraw-Hill, NY.

[Fromm 1995] Fromm, Ken. (1995). *Careers in Multimedia.* Ziff-Davis Press, CA.

[Gross et al. 1999] Gross, Phil, Elley, Frank, Tucker, Karen. (1999). *Director 7 and Lingo Authorized.* Peachpit Press, CA.

[Hawking 1993] Hawking S. (1993). *Black Holes and Baby Universe and Other Essays.* Bantam Publisher, NY.

[Johnson 1997] Johnson G., (1997). *Labview Graphical Programming*, 2nd edition. McGraw-Hill, NY.

[Lemay 1997] Lemay, Laura. (1997). *Teach Yourself Web Publishing with HTML.* Sams.net Publishing, IN.

[Nelson et al. 1995] Nelson, E.W., Best, C.L., McLean, W.G. (1995). *Schaum's Electronic Tutor of Engineering Mechanics*, 5th Edition. McGraw Hill, NY.

[Oppenheimer 1997] Oppenheimer S. (1997) Mathcad Professional offers Dynamic New Features. *Info World*, 19-31.

[Paul et al. 1997] Paul, C., & Whites, K., & Nasar, S. (1997). *Introduction to Electromagnetic Fields*, 3rd Edition. McGraw-Hill, NY.

[Plant 1998] Plant, Darrel. (1998). *Flash 3! Creative Web Animation.* Macromedia Press, CA.

[Quinn et al. 1997] Quinn, Donnie, & LeClair, Matt. (1997). *PhotoShop in a Nutshell: A Desktop Quick Reference.* O'Reilly & Associates, Inc., Sebastopol, CA

[Roberts 1997] Roberts, Nick. (1997). *The Official Guide to Authorware 4.* Peachpit Press, CA.

[Sawyer & Pronk 1997] Sawyer, Ben, & Pronk, Ron. (1997). *Digital Camera Companion.* The Coriolis Group Books, AZ.

[Seaman & Cline 1996] Seaman, Patrick, & Cline, Jim. (1996). *Website Sound.* New Riders Publishing, IN.

[Siegel 1997] Siegel, David. (1997). *Secrets of Successful Web Sites.* Hyden Books, IN.

[Spiegel et al. 1989] Spiegel, Murray, & difference, Donna (1989). *Schaum's Electronic Tutor of Statistics.* McGraw Hill, NY.

[Spiegel et al. 1998] Spiegel, Murray, & Moyer, R. (1998). *Schaum's Electronic Tutor of College Algebra*, 2nd Edition. McGraw Hill, NY.

[Sy 1999] Sy, B. (1999). Enhancing Science and Technology Education: Pattern-based learning and Curriculum leading to Web Deployable Courseware, Proceeding of the 99 World Conference on WWW and Internet, AACE, Honolulu, HI.

[Vaughan 1996] Vaughan, Warren. (1996). *Multimedia Making it Work*, 3rd Edition. Osborne McGraw-Hill, CA.

[Walsh 1995] Walsh, Aaron. (1995). *Destination Multimedia, Your Guided Tour to the Fascinating World of Multimedia.* IDG Books Worldwide, Foster City, CA.

[Yeaman & Dawson 1996] Yeaman, Jason, & Dawson, Victoria. (1996). *Macromedia Shockwave for Director.* Hayden Books, IN.

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Web-CS: Infrastructure for Web-based Competitions

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Abstract: Most cooperative environments that have been developed for the Web are designed for groups of people with "equal rights" working together on a task, possibly supervised by a single level of administrative authority. We present a Web-based infrastructure for cooperation between many different parties. The infrastructure is designed for Web-based competitions, involving an editorial board, designers of assignments or events, evaluators, different organizational layers, and of course contestants.

Web-CS is entirely Web-based: all the communication between the cooperating parties is achieved through communicating Web-browsers and Web-servers (augmented with Java-applets on the client side and a database system on the server side). This paper presents the global architecture of Web-CS and its implementation, which is currently being tried out in Hungary and in The Netherlands.

1. Introduction

Internet and its most prominent application: World Wide Web are becoming a part of the daily life of a growing part of the population (in highly developed countries). More and more professional and social activities that are centered around knowledge, information, or both are being supported by Internet technology. Teleconferencing hard- and software (for an example application see [LFL]), shared workspaces, and other Internet-based CSCW tools [BSCW, DReSS] mostly aim at supporting small groups of people who are on the same level of an organization's hierarchy. There may be supervision by a single higher level of authority (the "boss" or the teacher [BKPW]), who in theory has more rights than his associates, but who often needs the help of a system administator to actually use these rights. (Organizational rights often do not translate to information system rights.)

Applications or frameworks are still lacking for supporting activities in which many different parties are involved, each with different *rights*. Large *competitions* involve such a variety of parties. This paper presents a Web-based version of the Hungarian KöMaL competition. Competitions in different kinds of games, physical and intellectual sports, music and sciences are all organized in a similar way. The exact organization of KöMaL is described in Section 2. Generally speaking such competitions are organized according to the following scheme:

- There is an *editorial or supervisory board* that "organizes" the competition.
  - It decides which "organizations" may participate in the competition. Such organizations can be local game or sports clubs, schools, etc. Participating organizations are responsible for entering individual contestants into the competition.
  - It determines categories of contestants. It designs rules to determine in which category a contestant should be entered. The rules may use age, skill level, sex, etc.
  - It determines which "events" will take place, fixes dates or chooses assignments or quizzes, etc.
  - It may appoint referees (or judges).
  - It collects results and publishes overviews, on a daily, weekly, monthly or yearly basis.
  - It has the final authority to overrule questionable decisions of referees, or to change the rules of the competition.
- Participating organizations appoint *delegates* who enter contestants into the competition (or who approve applications of contestants). While this is not always visible in "real world" competitions, it is essential in a Web-based competition.
- *Designers* or *local organizers* propose *events* to the board. Examples of events are a chess or bridge tournament, or assignments and problems for a science competition. The board decides on the acceptance of such events.
- *Referees* (or judges or evaluators) determine the results of events. They are appointed by the board.

- *Interested third parties* (the press, the public) wish to view results.

Such a competition involves several layers of authority and responsibility. This hierarchical structure is the basis for keeping the whole competition *honest* and *fair*. If, for instance, contestants could enter themselves into the competition without going through an approval procedure, they might wish to enter into a "lower" category in order to have a better chance of winning.

The Web-based competition system presented in this paper is aimed at competitions that deal only with knowledge or information. The *events* are assignments or problems that are distributed through a Web-site. Contestants submit *solutions* to the editorial board who appoints *evaluators* to score these submissions.

The paper is organized as follows: Section 2 describes KöMaL, the paper-based competition that was brought on-line through our Web-based competition platform. Section 3 gives an overview of the architecture of Web-CS. It also describes some design details of essential components. Section 4 presents the current state of the project and its past and future developments.

2. The KöMaL competition: requirements for Web-CS

KöMaL stands for the Hungarian '**Kö**zépiskolai **Ma**tematikai és Fizikai **L**apok'. It is a Mathematical and Physical Journal for Secondary Schools. It is published monthly by the János Bolyai Mathematical Society and the Loránd Eötvös Physical Society.

2.1 Current Competition

The competition is centered around *exercises* or *problems*. Exercises are invented by *designers*, who send them to the KöMaL *editorial board*. An exercise is awarded a *level*, indicating the level of the students (third year, fourth year) for whom the problem was designed. The board makes a selection from the available exercises and publishes them in the journal, together with the results of earlier competition rounds. Each month about 20 mathematics and 10 physics exercises are published. An exercise that appears in the journal has an associated deadline, before which solutions must be received by the editorial board.

The students read the journal and formulate answers to the problems. They submit their solutions to the KöMaL-office. There the solutions are sorted by problem and distributed over a number of *evaluators*. Evaluators can specify their preference for a particular problem to the editorial board. The evaluators check the solutions they get assigned for correctness, "correct" them and give a grade. The corrected solutions and grades are sent back to the editorial board, who check them, and who may change grades if deemed necessary. The grades are entered into a computerized information system. The corrected solutions are sent back to the students. The evaluators recommend the best solutions for publication in a later edition of the journal. At the end of the term for the monthly competition round, the results are printed out and published. The competition takes one school year (nine issues and sets of problems). The student with the highest total score wins the yearly competition (for his or her level).

There is a separate competition for mathematics and for physics. The published results contain scores per student and per school. These results are not only printed in the journal but also published on the KöMaL home-page, at http://komal.elte.hu/. It is possible to review the results of the previous competitions, and to see the exercises and assignments of the current competition round.

KöMaL has already entered the digital era: students are allowed to submit solutions by e-mail, in Microsoft Word, LaTeX, Postscript or plain ASCII format. The solutions are printed at the KöMaL office, and sent to evaluators through paper mail.

The competition at present comprises seven, not necessarily disjoint, groups of users:

- **students**: they subscribe to the competition (subject to approval by a teacher) and submit solutions to the problems that are published in the magazine.
- **evaluators** (or correctors): they subscribe to certain problems, obtain a set of solutions for those problems (shortly after the deadline for submission) and correct and grade the solutions before a certain date.
- **editorial board**: this board consists of the publishers of KöMaL, who are responsible for the correctness of the contents of the magazine. The board selects the exercises to be published from the proposals sent in by the designers (see below). Board members can check the work of the evaluators and have the right to alter the grades. The board keeps track of the competition results and publishes this information.
- **designers**: they submit proposals for exercises and assignments to the board.

- **schools**: a school requests to take part in the competition. The school delegates its rights to a number of teachers.
- **teachers**: a teacher approves the application of students to enter the competition. He or she ensures that students are entered at the appropriate level.
- **third parties**: everybody who takes an interest in the competition: the public and the government who sponsors the competition. This group is not actually involved in the competition itself, but is interested in information about it.

As can be seen from the description above, the information flow associated with the competition involves a fair number of parties, each with different rights and responsibilities.

2.2 Requirements for Web-CS.

The aim of Web-CS is to provide a *fool-proof* infrastructure for Web-based competitions. By this we mean that the interaction between all the different parties and the Web-CS system should be uniform and simple to install and to use. The reasons are:

- Some (maybe all) parties involved in a Web-competition may have limited experience with computers or Internet tools.
- The parties involved in a competition may overlap. Many designers are also evaluators, and some of them are also teachers. The user-interface for these parties should be very similar.

Students may be working on problems and interact with Web-CS at home or at school. Therefore:

- The system should not require participants to have a permanent Internet-connection or to be connected for long periods of time.
- The system should not depend on a user always connecting from the same computer. Thus, the well-known "Cookie" mechanism cannot be used.

A *generic* competition system should be suitable for problems and solutions that are in very different formats. A mathematics competition involves formulas in questions and answers; a physics or biology competition may involve pictures and drawings; a computer science competition may involve the submission of program code. As a result:

- The published assignments may need a presentation format that is richer than the plain HTML-with-images style of the Web. All participants need to have a viewer for the chosen presentation format(s).
- Students need to be able to use a powerful document creation tool for writing their solutions. (Plain text and images are not sufficient.)
- Evaluators need viewer(s) for every document format which students are allowed to use in their submissions.

Most of the board's work should be automated:

- Problems should have unique identifiers.
- Solutions should have unique identifiers as well as the identifier of the problem they address.
- The distribution of solutions over evaluators should be automatic.
- The approval (and possible modification) of grades by board members should be easy.
- Approved grades should be published automatically and the corrected assignments sent back to the students.
- The scores should be published automatically, both monthly (which is the frequency of publication of the KöMaL journal) and yearly.

Students are eager to win, sometimes at the expense of others. Therefore the system should offer a number of security features to avoid cheating:

- Each participant in the system should have a distinct username and password. (An exception is the "public" who needs no password for viewing publicized information such as assignments and scores.
- Users must identify their "role" (e.g. teacher, designer, evaluator). Each role has associated *rights*. Users must not be able to perform tasks associated with a different role, or to select a role they are not allowed playing.
- Sensitive data, including passwords and solutions that are being submitted, should be communicated in encrypted form to prevent snooping attacks.
- The communication should be tamper-proof. A solution submitted by a student should arrive at the KöMaL site unaltered, and should also arrive at the evaluator's computer unaltered. Grades assigned by an evaluator should arrive at the KöMaL site unaltered.
- The KöMaL site should be well protected. Only board members should be able to access the database with grades directly, and be able to modify grades.
- Submission of (previously prepared) solutions should be possible without the solution being displayed on the student's computer screen.

The Web-CS software is intended for multiple applications.

- The presentation of the whole Web-site and the entire communication should be possible in the native language of the students. Since applications in Hungary and in The Netherlands were envisaged from the start, this means that the software must be language-independent.
- Some competitions may have a slightly different organization. The software needs to be adaptable to local situations. E.g., some organizations may require that students are entered into the competition by their teacher, while others may let students register themselves but ask teachers for approval afterwards.

A final requirement is availability.

- Web-CS should be able to handle a high volume of requests for assignments. It is expected that when new assignments are published many students will be eager to view and download the new assignments quickly.
- The submission and evaluation process is more spread out in time. Currently KöMaL receives and grades around 50.000 solutions (to about 300 problems) each year. Processing these data (and generating overviews) requires the use of a database system. The computing overhead in the evaluation of a solution is much higher than in delivering the problem to the student.

2.3 Comparable systems

Several Internet-based competitions already exist. However, none (of the ones we found) offer the functionality required for the KöMaL competition. Most non-commercial competitions we found are organized by North-American organizations.

- http://www.gcschool.org/abacus.html : This is the home page of the ABACUS International Math Challenge. This competition focuses on grades 4 to 8 and enables students to view the exercises (written as HTML pages) on the site. Solutions can be sent in by e-mail, after which they are corrected by the organizer of the competition. This competition has no automated system on its home page and is comparable to the current KöMaL-competition on the Internet.
- http://mathcounts.org : Mathcounts is the American National Mathematics coaching and competition program for seventh and eight grade students. On their home site a problem is published each week. For this problem no real competition exists. Mathcounts is a straightforward non-automated competition which has an interface to the World Wide Web for registering information, just as KöMaL already has. The actual competition is held at competition centers, where teams from schools physically gather on special competition days.
- http://math.uwaterloo.ca/CMC/CMCHome.html : The Canadian Mathematics Competition is a good example of a KöMaL-like competition which also has a home page to publish the answers and results of competition exercises. Again this competition is not an Internet based competition. The real competition is a tournament held in several cities in Canada.
- http://olympiads.win.tue.nl/ioi/ : Also the organization of the International Informatics Olympiad publishes the exercises used in their computing science competition, together with the solutions and other information via a WWW page. Again the real competition is held in annual tournaments in countries all over the world.

From these examples we see that Internet, and in particular World Wide Web, is used as an environment for publishing information concerning exercises, but that no integrated, automated support is offered for the organization of the competition. Existing environments for Web-workflow (e.g., Lotus Domino) and for CSCW [BSCW, DReSS] are not yet well suited for competitions because they lack the support for the many different roles that appear in competitions.

3 Web-CS architecture

To keep Web-CS simple, yet flexible, and to keep the client-part small as well, the system has been designed using off-the-shelf technology. The whole system consists of five parts:

- On the client-side the authentication and the execution of the user's *rights* are controlled by a trusted (signed) Java Applet. This applet communicates directly with a special KöMaL server.
- A standard Web-browser (at present this is Netscape Navigator) hosts the applet.
- A standard Web-server is used to serve information pages and the applet.
- A Java-based special-purpose server translates user requests to database queries and updates.

- All data about users, rights and grades are stored in a relational database. Web-CS uses the freely available PostgreSQL database system [PSQL]. This database system supports JDBC for the communication with the Java-based server part.

3.1 Basic module structure

The basic functionality of the system supports students, evaluators and other users in their typical activities. The requirement that no other software than a browser should be necessary to run the application suggests that each time a user starts the application, e.g. from the competition home page, sufficient software should be made available to enable him to interact with the rest of the system. This part, a Java Applet, is kept small in order to minimize download time. It is a *trusted* or *signed* applet to ensure that it has not been tampered with, and to enable it to access the user's file system.

The Web-CS applet offers a uniform interface for all users. When a user logs in (through the applet) the applet communicates with the database to verify the password and to determine the *rights* of this user. Depending on the role the user plays, different modules (rights) become available to the user. A user, who is unknown to the system, still can view the exercises and high scores, but has no other rights.

The applet is designed in an object-oriented way that corresponds to the different roles a user can play. Known (authorized) users can login directly. Students, who want to join the competition, and teachers are introduced to the system via the school. This introduction is subject to approval by a board member. Board members introduce users, playing other roles, such as designers and correctors. By adding (or removing) rights and some associated code, one can modify the system for competitions with a different organization.

3.2 Document formats and file-uploading

An important design decision for Web-CS is the choice of the document format(s) that can be used for problems and solutions. Because problems and solutions are somewhat similar documents (they deal with the same subject area) and because we want the user-interface to be very similar for all types of users we have opted to use one document format for problems and solutions. Two options were considered:

- It is possible to include a *special-purpose editor* in the Web-CS applet. This has the advantage that all users are automatically ensured to have the same editing environment. Unfortunately this option requires that a user is on-line in order to download and activate the editor from the Web-CS site. Developing a powerful editor-applet takes considerable effort, and the size of the applet would make downloads unacceptably long. For these reasons this option was not selected and implemented.
- A Web-browser can be told to execute a client-side application when receiving a document of a specific *MIME-type*. Web-CS provides one such special MIME-type for both assignments and solutions. All the users of the competition must configure their browser to activate a specific editor, chosen by the editorial board. For the Hungarian KöMaL competition Microsoft Word was chosen because all the secondary schools have PCs with this editor. Other competitions could opt for a different editor that is more suited for their particular audience.

Designers submit assignments to the editorial board. Students submit solutions to assignments. Evaluators submit corrected solutions and grades. To keep the user-interface uniform a single upload mechanism is needed. There are several options for implementing upload mechanisms:

- Use form-based uploading, as supported by most modern Web-browsers. This requires the Web-CS applet to send a request to the browser to first show an appropriate form. The upload is then performed beyond the control of the applet. (Whether the upload is "safe" depends on the use of a secure communication between the browser and Web-server in general. This is possible through SSL.)
- Use e-mail and attachments for uploading. This is not desirable because apart from the solution itself some control information needs to be submitted as well, including the identification of the assignment. Whether the communication is secure depends on the security of the used e-mail program. It is beyond the control of the rest of the Web-CS system.
- Use ftp upload to the server. This is not desirable because it requires duplication of the authorization mechanism. Ftp upload is also not supported by Web-browsers (only ftp download is). Thus, this would require a separate user-interface.

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- Use special upload software on the client, which is activated through a special-purpose MIME-type, just like with the editor. This is not desirable because we do not wish to force users to install any software on their system.
- Implement a special upload protocol within the Web-CS applet. This solution was chosen because it makes it easy to realize a secure communication, which is under the complete control of the applet.

Regarding the security of the communication the current Web-CS architecture leaves two options:

- The Web-CS applet and the Java-based Web-CS server can use the JCE, the Java Cryptography Extension, for encrypting all messages that are exchanged between the applet and the server. This allows for *secure uploads*, but *not for secure downloads*. Indeed, when, e.g., a solution is downloaded by an evaluator, it is downloaded to the Web-browser, using a special MIME-type to activate the client-side editor (which in the case of KöMaL is MS-Word). The download does not pass through the applet, and can thus not be decrypted by it.
- The Web-CS applet can communicate with the Web-server instead of the Web-CS server. The Web-CS server can easily be embedded into the Web-server using Servlet technology. The communication (both ways) between the browser and server can be secured through the SSL protocol (supported by most modern browsers, and by some Web-servers).

The issue of encrypted communication in Web-CS is still under investigation.

4. Current status and Future work

The Web-CS competition system can be tried using Netscape at http://wwwis.win.tue.nl/webcompetitie/. In this prototype only schools can subscribe. The editorial board can perform their supervisory tasks. Students can submit solutions to assignments. Evaluators can get an overview of the solutions they have to correct. They can grade and correct solutions and submit them. The prototype does not yet use encryption. However, because the client-side is entirely based on Java applet technology, the modified client software will be downloaded automatically once it becomes available. The transition to encryption uploads will not be noticed by the existing users.

Two field trials are currently being prepared. In Hungary, the development of the completely Web-based version of the KöMaL competition is continuing. In The Netherlands we are working with the organizers of the International Informatica Olympiad to use Web-CS, e.g., for the pre-selection of candidates for the annual computing science tournaments. Based on feedback from the field trials the user-interface may be updated (probably to give it a more "sleek" look and feel). Also, more ways to generate overviews and reports will be added.

A full version of this paper can be found at http://wwwis.win.tue.nl/webcompetitie/webnet99/.

5. References

[BKPW] J. Boegh, A.M. Krebs, L.O. Petersen, M. Wagner: A Web based Virtual College, Proceedings of WebNet98: World Conference on the WWW, Internet & Intranet, H. Maurer, R.G. Olson, eds., Orlando FL, 1998.

[BSCW] R. Bentley, T.Horstmann, K. Sikkel, J. Trevor, Supporting collaborative information sharing with the World Wide Web: The BSCW Shared Workspace system, Fourth International WWW-Conference, Boston, 1995.

[DReSS] A.T.M. Aerts, P.M.E. De Bra, M. Timmermans: DReSS 2.0: Lightweight Groupware for Hypertext Publishing on the Web, Proceedings of WebNet98: World Conference on the WWW, Internet & Intranet, H. Maurer, R.G. Olson, eds., Orlando FL, 1998. http://wwwis.win.tue.nl/~wsinatma/webnet98/

[LFL] C. Laufer, H. Fuks, C.J.P. de Lucena, Rio Internet TV - AulaNet: Using videoconference in Web-based Learning, Proceedings of WebNet98: World Conference on the WWW, Internet & Intranet, H. Maurer, R.G. Olson, eds., Orlando FL, 1998.

[PSQL] PostgreSQL: http://www.postgresql.org

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We wish to thank dr A. Benczur, V. Olah, and G. Kós of the KöMaL editorial board for posing the problem, and dr. A. Kiss (Eötvös Loránd University, Budapest) for the hospitality extended to one of us (PFMB) during part of the project.

Teaching Via the Web: A Self-Evaluation Game Using Java for Learning Logical Equivalence

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> *Don't worry about your difficulties*
> *in mathematics; I can ensure you*
> *that mine are still greater.*
> A. Einstein

1 A Motivating Question

We do not know if Albert Einstein's sentence could be useful to students for overcoming the wall of their ignorance in mathematics, or to face with the psychological block that prevents them from efficient learning. In this section, rather, we provide some basic motivation to use games for the learning of logic. A question arises: Why games?

A quick answer is on offer. Learning is a cognitive process, a "mental action," and it is well expressed by playing a game. Games involve competition, death and victory, deception and frustration, emotions—exactly as in real life. Games in logic, or logical games as a general case, are a natural learning environment, constructive situations, a "cognitive laboratory for studying deliberation, action, communication and information flow" [van Benthem, 1998], p.7. Besides more specific studies concerning the impact of emotions in the learning of mathematics, it is a fact that games are widely used in primary school teaching. As referred by [Hodges, 1998], Dienes and Golding relied on the funny side of games when they published the volume *Learning logic, logical games* for teaching logical notions to primary school children. For example, in one of their games a child has to stand up and try to list *things that he is not*. The other children listen to catch him out when he makes a mistake: the first child to spot a mistake takes over and has to list things that *she is not*. And so on.

We believe that there is a link between games and learning (of logic) that it is time to wake up to. At present, most of the education institutions involved in the teaching of logic encounter difficulties that sometimes grow with the students' age. At the same time, the use of games in teaching decreases with the student's age. To see an example, one can compare Dienes and Golding's book with the teaching material available today at the secondary and undergraduate levels.

As far as we know, the use of games in high school and undergraduate courses is not a very common experience. Nevertheless, there is a rich literature and some interesting tools on games as an explanation of concepts from logic, language and computation. For instance, [Doets, 1996, Hodges, 1997, Ebbinghaus and Flum, 1995] give three different ways to present Ehrenfeucht-Fraïssé games. These games are the main interest of this paper. Other games include semantic evaluation games (see for instance [Hintikka and Sandu, 1997] for a survey) and dialogue games for validity. For the semantic evaluation games, Tarski's World [http://www.csli.stanford.edu/hp/Tarski2.html] provides a simple game that students can use when a sentence evaluates in a way they did not expect. In dialogue games, the validity of some given formula is examined in terms of a two person, perfect information game. To the best of our knowledge, [van Benthem, 1998, Hodges, 1998] are the only lecture notes available at present that use games in logic and language as a unified perspective; [Abramsky, 1997] does the same for computation.

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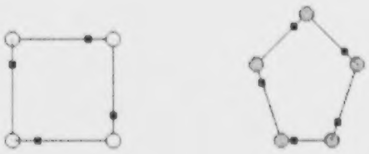


Figure 1: Example 1.

In this paper, we focus on games to be used in teaching logic. As a main result, we provide a Java application for playing logic in Ehrenfeucht-Fraïssé games as defined on graphs. Our system is available on the Web at [http://www.wins.uva.nl/~aiellom/java/ef].

2 *EF* Games

Ehrenfeucht-Fraïssé (*EF*) games are two player games. To fix intuitions, let us baptize the players in the game as Professor and Student—we call this paradigm the examination paradigm. Professor and Student play a game of some length on two structures, say $\mathcal{A}$ and $\mathcal{B}$. Professor wants to test the ability of Student as being examined on the question: Do you know how to compare the structures $\mathcal{A}$ and $\mathcal{B}$? A slightly different paradigm is the problem solving paradigm, where Student is being examined by Professor in solving a problem and either '$\mathcal{A}$ is similar to $\mathcal{B}$' or '$\mathcal{A}$ differs from $\mathcal{B}$.' Whatever paradigm one chooses it makes no difference here. Professor and Student play as follows. Professor and Student take turns to choose elements from the structures. At each turn, Professor moves first and chooses an element from either $\mathcal{A}$ or $\mathcal{B}$. Student replies by choosing an element of the other structure. Student loses if the set of atomic formulas satisfied by the elements chosen so far from one structure differs from the set of formulas satisfied by those elements chosen in the other structure (regardless of which player chose which elements). We refer to [Doets, 1996] for a general discussion on Ehrenfeucht-Fraïssé games. What is essential to define, rather, is the notion of strategy. A *strategy* for a player in a game is a set of rules which tells the player how to move, depending on what has happened so far. A strategy is *winning* if the player that uses it wins every play of the game.

To generalize our discussion, in what follows we shall refer to Professor and Student to their well known names. Thus, Professor is for `Spoiler` and Student is for `Duplicator`.

2.1 Some Examples

Is it time to play? By now we know the rules and we know that we can gain from playing, so it appears to be the time for some real games.

Example 1. Suppose that the set $A = \{a, b, c, d\}$ equipped with a relation $R_A = \{\langle a, b\rangle, \langle b, c\rangle, \langle c, d\rangle, \langle d, a\rangle\}$ and $B = \{a, b, c, d, e\}$ with $R_B = \{\langle a, b\rangle, \langle b, c\rangle, \langle c, d\rangle, \langle d, e\rangle, \langle e, a\rangle\}$ are given (as shown in [Fig. 1]).

The resulting structures are different, but the question is: how much different? In other words, how many turns will `Spoiler` need to win?

A possible play would develop as follows:

1. `Spoiler` chooses a in A, `Duplicator` answers b in B. Nothing very interesting happened here, both players just chose an element. Intuitively, both players thought: "exists x" in terms of the language, which holds of both sets A and B.
2. `Spoiler` chooses c in A, `Duplicator` answers d in B. Here `Spoiler` knows that $\forall x \exists y \langle x, y\rangle \notin R$ is true in both structures. So, he can't win yet, but he is preparing his victory.

3. `Spoiler` chooses d in A, `Duplicator` has no good moves that leave a partial isomorphism. `Spoiler`'s final win is justified by his thinking: "Well, the structure with domain A can be described by $\forall x \exists z (\exists y(\langle x, y\rangle \in R \wedge \langle y, z\rangle \in R) \wedge (\exists w(\langle z, w\rangle \in R \wedge \langle w, x\rangle \in R)))$, while the structure with domain B can not."

In the next section, we justify formally why `Spoiler`'s way of thinking brought him to win.

Example 2. Suppose $A = \{1, 2, 3\}$, $B = \{8, 9, 10, 11\}$ and $<$ be the usual linear order. A possible play is the following:

1. `Spoiler` chooses 2 in A, `Duplicator` answers 9 in B;
2. `Spoiler` chooses 11 in B, `Duplicator` answers 3 in A;
3. `Spoiler` chooses 10 in B, `Duplicator` has no moves.

Looking at this play and at the thoughts that drive `Spoiler` and `Duplicator`, it should give us hints of the underlying strategy they are using. The thoughts of the two players in this example are analogous to those highlighted in Example 1. One thing must be noticed though: the formula $\exists x \exists y \exists z \exists w : x < y < z < w$ does not describe the structure $\langle A, <\rangle$ but the structure $\langle B, <\rangle$. This formula is quite easy to write by looking at the picture of the two structures [Fig.2]; but one can do better and find more elegant formulas. Finding these formulas is a pedagogically good exercise. In this example, one is $\exists y \exists z : (y < z \wedge (\exists x : x < y \wedge \exists w : z < w))$. The elegance resides in the quantifier rank of the formula, notion that we define formally in the next section.

Example 2 is an instance of a more general game that can be played: the game on two structures having domains of different cardinality and equipped with linear ordering.

Example 3. A pedagogically interesting example is that of playing on the integers $\mathbb{Z}$ and the rationals $\mathbb{Q}$ equipped with the usual $<$ ordering relation.

As in the above example `Spoiler` has a winning strategy for all games of 3 or more moves. This is due to density, a property that $\mathbb{Q}$ has, but $\mathbb{Z}$ doesn't, and that can be expressed by the first order formula: $\forall x \forall y : (x < y \Rightarrow \exists z : x < z < y)$. Again, notice that the number of nested quantifier is 3, like the number of turns that `Spoiler` needs to win.

Example 4. Another appealing example of games on ordered sets is that playable on the rationals $\mathbb{Q}$ and the reals $\mathbb{R}$ equipped with the usual linear order $<$. It is a fact of model theory that their models $\langle \mathbb{Q}, < \rangle$ and $\langle \mathbb{R}, < \rangle$ cannot be distinguished in first order logic. This means that it is not possible to write a first order formula that is true in $\langle \mathbb{R}, < \rangle$ and false in $\langle \mathbb{Q}, < \rangle$. For instance, we can express that the rationals and the reals are dense. But there is no way to express, say, that between 314/100 and 315/100 there is a number representing the ratio between the circumference and its radius.

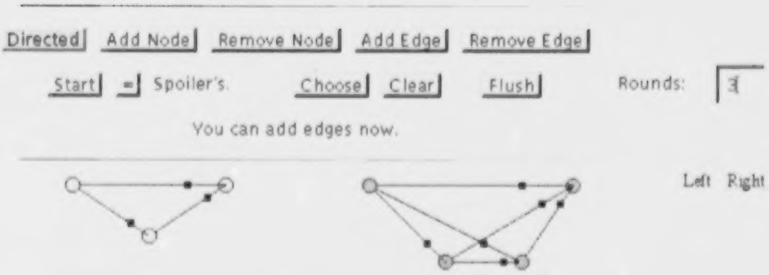
One can familiarize oneself quite easily with the notion of first order expressibility by playing an EF game on $\langle \mathbb{Q}, < \rangle$ and $\langle \mathbb{R}, < \rangle$ as follows: `Spoiler` tries his best in as many rounds as he wants; but if `Duplicator` knows how to play, `Spoiler` has no chance of winning. Thus, `Duplicator` has a winning strategy for every length of the game, which means that every first order formula which is true on the rationals is also true on the reals.

In terms of learning and getting feelings of model-theoretic concepts, it is useful to play a game on structures where the domain is a set of numbers. Moreover, making the moves for both `Spoiler` and `Duplicator` is a unique experience for the student that should be integrated with formal explanations.

2.2 The Adequacy Theorem

We have been educated to compare *sets*. Elementary school has first provided us for sets of sweets, big and small. A common question then was: "What is bigger?" More complex issues appear later. For instance, we have been trained by comparing mathematical objects as algebraic expressions and polynomials, and we meet equality. Moreover, Euclidean geometry told us more on comparison by providing new insight into equality of figures on a plane, or solids in the 3-dimension space. But we have not been well trained in comparing *structures*. For doing this, we introduce one well known and important concept in logic: *elementary equivalence*.

Elementary equivalence is a basic notion in model theory. We refer the reader to [Doets, 1996] for general terminology. Informally, elementary equivalence is the property that two structures have when they model the same



You can add edges now.

Figure 2: drawing the graphs.

set of sentences of a given language. Formally, we consider a language L and two structures that interpret L, that we call *L-structures*. We also stipulate the proviso that the vocabulary of L is fixed, finite, and contains only relation symbols and constants (no function symbols).

Definition 1 (Elementary equivalence) *Let $\mathcal{A}$ and $\mathcal{B}$ be L-structures. We say that $\mathcal{A}$ and $\mathcal{B}$ are* elementarily equivalent*—in symbols: $\mathcal{A} \equiv \mathcal{B}$—if and only if $\mathcal{A}$ and $\mathcal{B}$ satisfy the same sentences of L.*

Definition 1 has a simple extension that accounts explicitly for the quantifier rank of the sentences of L. Recall that the *quantifier rank* $d(\varphi)$ of a formula φ is the number of nested quantifiers occurring in it (see for instance [Doets, 1996]).

Definition 2 (n-Equivalence) *Let $\mathcal{A}$ and $\mathcal{B}$ be L-structures and n be a natural number. We say that $\mathcal{A}$ and $\mathcal{B}$ are* n-elementarily equivalent*—in symbols: $\mathcal{A} \equiv_n \mathcal{B}$—if and only if $\mathcal{A}$ and $\mathcal{B}$ satisfy the same sentences of L of quantifier rank $\leq n$.*

We are now ready to state the result by Ehrenfeucht (1961) which allows us to explain elementary equivalence in terms of games. We denote by $EF_n(\mathcal{A}, \mathcal{B})$ the Ehrenfeucht-Fraïssé game of length n (with n a natural number) on the structures $\mathcal{A}$ and $\mathcal{B}$.

Theorem 1 (Adequacy Theorem) *For L-structures $\mathcal{A}$, $\mathcal{B}$ and $n \geq 0$ the following are equivalent.*

(a) `Spoiler` *has a winning strategy in $EF_n(\mathcal{A}, \mathcal{B})$.*

(b) $\exists\varphi : d(\varphi) \leq n$ and $\mathcal{A} \models \varphi$ and not $\mathcal{B} \models \varphi$, i.e., $\mathcal{A}$ and $\mathcal{B}$ are not n-elementarily equivalent.

We have so far stressed the importance of EF games in the context of learning model theoretic notions. By the Adequacy Theorem we get what we hinted in the examples above, namely, the formal correlation between winning strategies and syntactic properties, such as the quantifier rank of a formula.

3 ...Via the Web

We now describe how we have brought these ideas into a Java applet—we called our application $ELgA$. We chose Java for its well known features of portability, integration in HTML documents and interface primitives. All these features allow $ELgA$ to be of potential interest for a wide audience as the WWW presently has. $ELgA$ provides a self-evaluating environment for students in the context of graphs, where both directed and indirected graphs can be played on. (Recall that a *graph* is a structure $\langle G, E \rangle$. The elements in G are called *nodes*; E is a binary relation on G whose elements are called *edges*. A graph is said *directed* if E is symmetric, and *indirected* if E is asymmetric.) Reflexive relations are also allowed: edges that start and end in the same node can be constructed.

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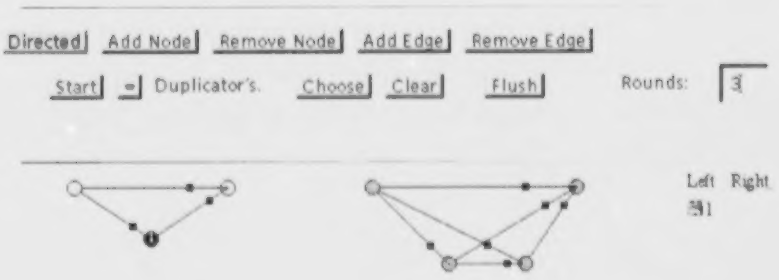
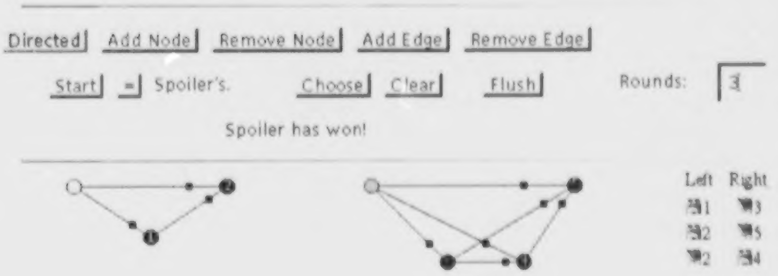

Directed
Add Node
Remove Node
Add Edge
Remove Edge
Start
=
Duplicator's.
Choose
Clear
Flush
Rounds:
3
Left
Right
1

Figure 3: beginning to play.


Directed
Add Node
Remove Node
Add Edge
Remove Edge
Start
=
Spoiler's.
Choose
Clear
Flush
Rounds:
3
Left
Right
1
3
2
5
2
4

Spoiler has won!

Figure 4: `Spoiler` has won.

3.1 Sessions

A session starts by choosing whether to have directed or indirected graphs. Then, thanks to a graphical editor it is possible to draw the two graphs.

The first move is granted to `Spoiler`. The node that he chooses is highlighted in black and a log of moves on the left side is updated. During a game it is possible to change the number of rounds, to decide whether playing with equality or not. A status bar always indicates who's winning, if a move is legal or not, and it helps students in their self-evaluation learning process.

Once a game is over, it is possible to play again on the same structures, eventually modifying some parameters like the number of rounds and the use of equality, or to change the game by drawing new graphs.

3.2 Example

Let us consider Example 2 above. To be able to play that game we have to input the structures. The relation $<$ is asymmetric, thus we play on directed graphs. We add 3 nodes to the left side and 4 to the right. We connect the nodes as shown in the [Fig. 2]. We are now ready to play. We set the number of rounds to 3. `Spoiler` can pick the central node on the left side (see [Fig. 3]). Then, `Duplicator` picks one of the two central nodes on the right side, and so on as in Example 2. The final situation is depicted in [Fig. 4].

4 Future Developments

The self-evaluating paradigm is not the only one from which a student can benefit. There are at least two further approaches that we plan to explore in the future.

- The possibility of playing against a *perfect opponent* should be investigated. The student that hasn't understood the game yet, should be able to play it against a perfect player. By loosing the first games, a perfect

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player will make the student eager to develop a new strategy and to play again, thus improving his/her understanding of the notion in the game. A client-server architecture would be the best solution, keeping the Java applet as the interface with the user on the client and implementing the perfect opponent as a running program on the server. Whenever the user makes a move, a request is sent to the central server (via a usual CGI architecture), that computes the best possible move.

Computing such move amounts to checking for partial isomorphisms between graphs. A heuristic should be devised if the player to automate is `Spoiler`. In fact, if the structures in the game are not isomorphic, `Spoiler` should pick his elements in such a way that he wins in the least possible amount of moves. On the other hand, it is easy for `Duplicator` to win in the case there is an isomorphism. He has to find the isomorphism and always play isomorphic elements.

The problem of computing moves is exponential in the dimension of the graphs on game. However, given the low number of nodes in each graph, the system would still give an output in a very short time. The server computing the moves for the automatic player could be easily implemented in Prolog or, to increase performance, in C++. The student would have the possibility to play against a perfect player and to switch sides while playing, or to look at the same game as being played between perfect players.

- Another paradigm to explore is that of having the student play against a *human expert*, say, a teacher. The teacher does not necessarily have to play the best move, and he/she can decide what to do in order to let the student learn. A space for written comments should then be available. The teacher could comment each move and explain what is going on to the student.

  The implementation of these features could be obtained by the Java capabilities for establishing TCP/IP connections. The connection could be either one-one (teacher-student) or one-many (teacher-class).

Acknowledgments

The idea of implementing Ehrenfeucht-Fraïssé games came up while the second author was attending Johan van Benthem's course *Logic and Games*. We are grateful for his suggestions and the time spent to discuss the topic. We thank Johan van Benthem and Fausto Giunchiglia for useful feedback on previous versions of this article. This article was written while the first author was visiting the ILLC, Amsterdam. He thanks ILLC for his fruitful visit. The research of the second author is partially funded by CNR, borsa-203.07.27, 9/4/97.

References

[Abramsky, 1997] Abramsky, S. (1997). Semantics of Interaction. In *Lectures notes of Joint Newton Institute CLiCS II Summer School on Semantics and Logics of Computation*. Cambridge University Press. http://www.dcs.ed.ac.uk/home/samson/coursenotes.ps.gz.

[Doets, 1996] Doets, K. (1996). *Basic Model Theory*. Studies in Logic, Language and Information. CSLI Publications & FoLLI, Stanford, CA.

[Ebbinghaus and Flum, 1995] Ebbinghaus, H.-D. and Flum, J. (1995). *Finite Model Theory*. Springer.

[Hintikka and Sandu, 1997] Hintikka, J. and Sandu, G. (1997). Game-theoretical semantics. In van Benthem, J. and ter Meulen, A., editors, *Handbook of Logic and Language*, pages 361–410. Elsvier Science B.V., Amsterdam.

[Hodges, 1997] Hodges, W. (1997). *A Shorter Model Theory*. Cambridge University Press, Cambridge.

[Hodges, 1998] Hodges, W. (1998). Invitation to logical games. Lecture notes. Mathematics Department, Queen Mary's College, London.

[van Benthem, 1998] van Benthem, J. (1998). Logic and games. Lecture notes for a graduate course. ILLC, UvA.

Evaluation And Comparison Of Web-Based Testing Tools

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Abstract: In this paper, we evaluate popular Web-based tools for test design, implementation, delivery, automatic grading and result analysis. We compare these tools with respect to the variety of question types that support, the capabilities for multimedia use, the security, the easiness of development, maintenance and delivery of tests, the automatic grading and the statistical analysis of the results. Based on these criteria and practical experience with the tools, we concluded that the best ones were Cyber Exam and QuestionMark Perception.

1. Introduction

The growth of the Internet in the last decade has given rise to the demand for virtual classrooms and distant learning. The concept behind this was that, through the Intranet of a University or even the Internet, a group of people consisting of a teacher and his students can 'meet' and perform a lecture via their computers. Recently, significant progress has been made towards this direction. The integrated support of text, graphics, audio and video by the Web makes it an appropriate vehicle for learning and knowledge acquisition. The student is actively involved in the learning process using interactive tools and collaborating with the teachers and other students [Hall 97, Brooks 97, Khan 97, Economides 99, Economides 97, Mamoukaris 99].

An important parameter regarding distant learning is the taking of the examinations of a course via a computer network. To facilitate the teachers in authoring, delivering, grading and analyzing the exam tests, special software tools had to be designed. Recently many tools that facilitate the exam taking process have appeared. These tools can be installed in a server and then used by teachers and students, replacing the classical form of written examinations or helping the self-evaluation of the student progress.

Although all of them share a basic template, they have major differences in their characteristics. In this paper, we evaluate the most popular Web-based testing tools, which are:

- Question Mark Perception of Question Mark Corporation [QuestionMark Perception]
- Hot potatoes of Half-baked Software [Hot potatoes]
- Test Maestro and School Maestro Internet Publisher of Russ & Ryan EdWare [Test Maestro]
- Examiner and FastTEST of Assessment Systems Corporation [Examiner]
- LXR * TEST of Logic Extension Resources [LXR*TEST]
- WebCT of World Wide Web Course Tools [WebCT]
- Cyber Exam of Virtual Learning Technologies [Cyber Exam]
- C-Quest of Cogent Computing Corporation [C-Quest]

We compare these tools with respect to the following criteria:

- Variety of question types
- Multimedia use
- Security
- Easy development, maintenance and delivery of tests
- Grading
- Statistical analysis of results

In the following section, we briefly present each one of these software tools. In section 3, we compare them with respect to the most important criteria. Finally, in section 4, we conclude and suggest directions for improvement of these tools.

2. Testing Tools Presentation

In this section, we present the evaluated testing tools.

2.1 QuestionMark Perception:

This is the best product of QuestionMark Corporation, a company that specializes in the design of testing tools. It helps authors to create questions easily with no need for HTML knowledge. The author follows on-screen instructions or uses a question wizard for even easier question generation. The question types supported are: Multiple choice, Multiple response, Explanation, Numeric, Selection, Text Match. Every question or test can have a time limit. Multimedia use is quite easy, and therefore any type of file (graphics, pictures, diagrams) can be inserted in a particular question. These files should be in .gif or .jpg format. Students use unique usernames and (if needed) passwords to access the test.

Perception generates tables of the grades achieved by the students that took the test, with the percentages of their right or wrong answers. This feature is remarkably useful as it allows the instructor to justify the correctness of a test or even a particular question of the test.

A disadvantage of Perception is the lack of support for Unix, requiring Windows NT environment only.

Generally, Perception is one of the top testing tools, and scores high in all the major criteria. It combines easiness, security, variety and statistical analysis in a very satisfactory degree.

2.2 Hot Potatoes:

This program is a collection of six utilities, each generating a different type of question, namely JBC for multiple choice, JCloze for filling blanks in a text, JQuiz for text insertion, JCross for crossword generation, JMix for ordering mixed words of a phrase and JMatch for text match questions. All questions can be time-limited. Hot Potatoes constructs the question Web pages automatically, immediately after the instructor inserts the questions and answers. These pages can then be stored in any Web server in order to be used by the students.

The major disadvantages of Hot Potatoes stand in the statistical analysis and in the security of the tests. It does not provide any kind of access control. Hot Potatoes can be used in unofficial testing and student self-evaluation.

2.3 Test Maestro & School Maestro Internet Publisher:

Test Maestro and its complementary program have a major difference to the other packages. They generate written papers for exams and not Internet-based tests. Questions supported by Test Maestro are: True/False, Fill in Blanks, Multiple Choice, Short Answer and Text Matching.

It is fully compatible with MS Office programs, and therefore Excel plots, Word documents or even mathematical equations can be easily inserted in a question. The generation of a test is password protected and therefore access to the question bank is protected.

Statistical analysis as well as automatic grading is totally absent from Test Maestro. These functions are left for the instructor to perform, since the exams generated are in written form.

2.4 Examiner:

Examiner is generating tests from a bank of previously developed questions. It can provide instant feedback and explanations to the student after he answers a question. Examiner is very efficient in the use of multimedia, as video or audio files can be inserted in a question. So, the instructor can develop questions about the recognition of a sound or a word.

However, the instructor can only construct Multiple Choice questions, which may have a time limit. Furthermore, the program can show the result to the student, if required, or present a detailed analysis to the instructor. Then, it is possible to store the results in a database and produce critical statistical values as mean, median and standard deviation.

2.5 FastTEST:

The main feature of FastTEST is the development of a question bank from which the instructor can pick the ones needed for his test. The program supports word processor features (Bold, Italic, Underlined, Colored Text, variable font size, left, right, centered alignment) and is fully compatible with MS Office. Its questions can be Multiple Choice, True/False, and Open Answer.

Although FastTEST is quite efficient in the statistical analysis of the test grades, it does not produce any results automatically. It only provides windows for the instructor to insert the numbers of his personal analysis of the results. Access control is accomplished by passwords on the instructor end, but not on the student end.

The main disadvantage of the program is the limited use of multimedia. Only pictures of type .bmp and .wmf can be attached to a question.

FastTEST is designed mainly for generation of papers for written exams. Its supplement, FastTEST On-Line, can publish the tests on a server, and have them time-limited, but it can only record the answers without doing any extra analysis on them. Therefore, it is in a significantly lower level than the other competitors.

2.6 LXR*TEST:

This program is designed for both written and computer-based examinations and can be definitely regarded as one of the best programs of its kind as it is very efficient in almost all the aspects of interest. The question types supported are: Multiple Choice, True/False, Text Matching, Numeric and Open Answer. Time-limited questions are also allowed. A major advantage of LXR*TEST is the multimedia use. Apart from the typical file types that are supported, a user can attach QuickTime movies in a question, a feature only present in this program.

The instructor is again able to develop a test using a previously built question bank. The individual questions are set up in a word processor-like environment with all the advantages that such a function provides. It can provide special grading for each answer so that the instructor can give higher marks in some questions. Standard security is provided with passwords not only for the instructor but also for every individual student.

The LXR*TEST is one of the best in the statistical analysis of the results. The program can record and store all the answers in a database and automatically create a table with the grades of all participating students. Then, the instructor can inspect the answers in every question of a particular student. Also, LXR*TEST generates a printable list of the grades of all students that can be attached to a notice board.

2.7 WebCT:

WebCT is not just a test authoring tool, but a teaching environment with functions like storing of lecture notes, support of mailing list for students, discussion area, chat area, glossary, index, syllabus, timetable, on-line exams and much more. Specifically, the exam generation section of the program is quite simple and the instructor can easily develop tests. It supports the following question types: Multiple Choice, Text Matching, Short Answer and Paragraph, with a choice of time limits. WebCT's special feature is the ability of giving negative values to special answers in order for the students to loose points when selecting that particular answer. Multimedia use is supported very efficiently. Access control is achieved by unique usernames and passwords that are needed not only to access the exams but also to log on to the server where WebCT is stored. The student answers and grades are stored in a database for further analysis by the instructor.

Generally, WebCT provides a very efficient teaching environment but it is not specialized in testing.

2.8 Cyber Exam:

The Cyber Exam provides all characteristics of a testing tool at very high quality. Its working environment is a web browser like Netscape Navigator and MS Internet Explorer. It supports many question types: Multiple Choice, Multiple Response, True/False, Short Answer, Fill in Blanks, Text Matching and Essay. Time-limited questions are also present. Multimedia can be used very efficiently. Apart from the usual type of pictures, audio and video, JAVA applets are supported and can be easily inserted in a question. Security measures are standard, providing password protection in both the instructor and the student ends. It provides a very high quality of statistical analysis. Immediately after a student completes a test, the program automatically grades it and is able to present the result, if wanted, to him. Cyber Exam also produces statistical reports, such as higher/lower grade, mean and standard deviation of all the grades. The results can be easily imported in a spreadsheet package like Excel or even a statistical package like SPSS. Cyber Exam can be easily regarded as one of the top programs in the area. It achieves a high level of functionality and quality for all criteria.

2.9 C-Quest:

This program is a collection of tools helping test authoring and development. These tools are: C-Quest db for the question database construction, C-Quest Test for the written examinations generation, C-Quest Web for computer-based exams, and C-quest Echo for exams via e-mail.

The questions types supported are: Multiple Choice, True/False and Multiple Response. Time limits are allowed for every type. Many multimedia file types can be inserted in the questions. These can be pictures (.gif or .jpg), sound (.wav or .mid) and video (.avi). Access control is password protected with the instructor giving the usernames of the students. After the completion of the test by a student, the results are transported to the C-Quest Web Administrator. There, the generated tables can be sorted, printed or even be exported to statistical and spreadsheet packages.

Generally, C-Quest is a nice test development program, but there is nothing special to it in order to be considered as one of the best. In all aspects, it scores about average.

3. Testing Tools Comparison

In this paper, we compare Web-based testing tools with respect to some criteria. Our experience has shown that they have major differences in almost every aspect we examined. On every criterion, there were tools that scored very high, while other performed below average. In this section, there is a complete description and scoring of the testing tools. This description is made separately for each criterion and is followed by a table that gathers the given information.

Regarding the criterion of the different Question Types supported by the tools, we remark that the standard number of types is five. However, Hot Potatoes and Cyber Exam support more types. Specifically, Hot Potatoes is the only program that can generate crosswords and sorting out a phrase from its words. Cyber Exam, apart from six basic question types, supports essays that have to be e-mailed to the professor for manual grading. Therefore, Cyber Exam has to be considered as top in this criterion. Examiner, FastTEST and C-Quest score the lowest.

The criterion of Multimedia Use can be a very decisive factor as there are major differences between the software tools in this area. LXR*TEST, WebCT and Cyber Exam can be considered as being the top under this criterion. In these packages, almost every type of multimedia file is supported. Test Maestro and FastTEST, can be considered unsatisfactory.

The criterion of Security is a very important issue for a test delivery tool, since the exams have to be accessed by a very special group of people, the instructor and the students of a particular course. Most of the tools set up their own security parameters. However, Hot Potatoes does not consider the security issue and leave it to the instructor to decide what to do. Therefore, it is considered of a lower standard than its counterparts.

Simplicity of test authoring and test taking is another criterion we examine. QuestionMark Perception, WebCT and Cyber Exam provide very user-friendly environment for test generation using wizards or web browser interfaces.

Automatic Grading with special values for particular answers is a criterion supported by half of these tools. Perception, Examiner, LXR*TEST, WebCT, Cyber Exam and C-Quest can be considered as top since different scores can be assigned to different questions.

Finally, Statistical Analysis is a criterion for which there are great differences between the evaluated tools. Some of them, like Hot Potatoes and Test Maestro have no or very limited support of statistics of the results. FastTEST, WebCT and C-Quest perform standard statistical analysis. Perception, Examiner, LXR*TEST and Cyber Exam are superior to the others providing advanced and detailed statistical analysis.

After extensive investigation and experimentation with these testing tools, we came out with the following comparison table. In this table, we score the performance of these tools with respect to important criteria.

	Q.M	H.P.	T.M.	EX.	F.T.	LXR	Web	C.E.	C-Q
Question Types	5	6	5	1	3	5	5	7	3
Multimedia Use	B	B	-	B	C	A	A	A	B
Security	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Simplicity	A	B	B	B	B	B	A	A	B
Automatic Grading	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
Statistical Analysis	A	-	-	A	B	A	B	A	B
Cost in USD	neg.	Free	35	875	199 OL 150	1199	neg.	neg.	db: 160 Test: 152 Web: 602

The shortcuts refer to the names of the testing tools and are the following:

Q.M.	QuestionMark Perception
H.P.	Hot Potatoes
T.M.	Test Maestro
EX.	Examiner
F.T.	FastTEST
LXR	LXR*Test
Web	WebCT
C.E.	Cyber Exam
C-Q	C-Quest

We also use the following scores:
A= Excellent
B= Very Good
C= Good

The sign (neg.) means that the price is negotiable between the company and the buyer depending on the number of instructors/students that are going to use the software.

4. Conclusions

The analysis we made in the previous Section states clearly that, overall, Cyber Exam and QuestionMark Perception can be considered as the best choices for Web-based testing. They scored very high in all criteria and had no major drawbacks in every aspect. Therefore, Cyber Exam and QuestionMark Perception can be considered as an option.

On the other hand, Hot Potatoes can be used for easy creation of unofficial questions and tests. Test Maestro is better suited for the production of test papers for written examinations, while Examiner is a tool that scored well in almost every criterion except the one regarding the supported question types, which is a fact that makes it unattractive. FastTEST and C-Quest are considered to be of a lower standard than its counterparts and LXR*TEST can be marked as the third best choice after the two we mentioned above. Finally, WebCT is a great selection not only for creating Web-based tests, but also for the generation of complete university courses that are going to be taught using the Web instead of the classic lecture-based teaching.

References

[Brooks 97] Brooks D., (1997). *Web Teaching: a guide to designing interactive teaching for the world wide web*, Plenum Pub Corporation.

[Khan 97] Khan B., (1997). *Web-based Instruction*, Englewood Cliffs, N.J.

[Hall 97] Hall B., (1997). *Web-based Training Cookbook*, Wiley.

[Economides 99] Economides A.A. & Georgiou A.C. & Karagiannidis C. (1999). Acceptability Evaluation of Web Based Courses, *19th World Conference on Open Learning and Distance Education*, Vienna, ICDE 1999

[Economides 97] Economides A.A. (1997), Training and Continuing Education on Internet, *3rd Conference on Informatics and Telematics Applications*, Thessaloniki, 1997

[Mamoukaris 99] Mamoukaris K. & Economides A.A. (1999), Web-based distance education systems, *17th Annual Conference AOM/IAOM*, San Diego, 1999

[QuestionMark Perception] http://www.questionmark.com/

[Hot Potatoes] http://web.uvic.ca/langcen/halfbaked

[Test Maestro] http://www.rredware.com

[Examiner] http://www.assess.com/examiner.html

[FastTEST] http://www.assess.com/fasttest.html

[LXR*TEST] http://www.lxrtest.com

[WebCT] http://www.webct.com

[Cyber Exam] http://www.vlearning.com/cyberexam/

[C-Quest] http://www.cogentcorp.com/ccc/cq.html

The Evolution of Electronic Pedagogy in an Outcome Based Learning Environment: Learning, Teaching, and the Culture of Technology at California's Newest University- CSU Monterey Bay

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Abstract: CSU Monterey Bay is the newest university in the CSU system. CSUMB's vision statement distinguishes the institution from others in the system by promoting learning paradigms of Outcome Based Education (OBE) and communication technologies of distributed learning (DL). Faculty are committed to the experimental use of technologies as resources to people, catalysts for learning and providers of increased access and enriched quality learning. The university begins its fifth year in its commitment to create a culture of innovation in conceptual design and organization; embracing outcome based education and distributed learning paradigms. Baldwin's formative narrative of the institutions experiences concludes that: 1) CSUMB has had difficult to find faculty with sufficient pedagogical experience with multimedia teaching tools and outcome based education to move directly to the new paradigm, 2) the organizational structure of ULR Committees has mandated "assessment by courses" rather than a true OBE approach.

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Introduction

In 1994, California State University Monterey Bay was among the first public universities to develop a technological infrastructure- from the ground up - to deliver an educational curriculum using a multimedia Intranet/Internet design. In conjunction with the technology, the university planning faculty began with a mandate to create an "outcome based" educational model of collaborative learning and teaching that would promote transdisciplanary learning. Our ability to do so was based on support from defense conversion funds from the military as well as funding from the CSU system. CSUMB was created on the site of the former military base Fort Ord and from the beginning we were viewed as a national model demonstrating how to convert a military base into an economic engine, mediating the negative impact of a military base closure on the tri-county region. During the past four years, CSUMB has explored how to fully utilize the computer-mediated multimedia technology that was installed as a distributed method for course delivery. As we move into our fifth year of operation, we are taking our first steps toward integrating our teaching technologies with outcome base learning, enrollment and assessment management systems. "Contact hours," "seat time", and "the virtual campus" are constantly part of our day to day dialog. CSUMB is on the forefront of the CSU system's expressed interest to develop an outcomes based educational system which would replace the traditional credit-based system of graduation. Those hopes, as well as our recognition of the dramatic demographic shifts in the California population are reflected in the institution's vision statement, found at http://www.monterey.edu/general/vision.html. This "transformation" has occurred under the watchful eye of the state of California during a political period in which affirmative action has been challenged in California and and rival on-line university systems are being created both nationally and globally. For these reasons, CSUMB is a fascinating experiment in the application of distributed learning technologies to the teaching and learning paradigm of OBE. All of this in a political atmosphere of multiculturalism and transdisciplinary training! We do not have traditional majors or departments.

Distributed Learning at CSUMB

Where distance learning is understood to be pedagogy that attempts to replicate the classroom ambiance across geographic space, distributed learning (DL) involves the acceleration of interactions between teachers, researchers and students using electronic networks to communicate. DL may use the technologies of distance learning, but the focus in not on providing "education at a distance", it is on providing learning on demand regardless of the student or teachers' location - on or off campus. When integrated into instruction, the technology encourages teachers and students to reevaluate the traditional role relationships that have existed in western education. We eliminate the temporal and spatial restrictions on the instructional process and blur the distinctions between "distance" and "campus-based" education. changing the way in which students gain knowledge and faculty teach. California has a state wide initiative that is intended to leverage institutions to weave outcome based learning and technology together. The OBE philosophy is embodied in the Cornerstone Report and the use of technology is a CSU initiative. *The goal of the CSU technology initiative, as we understand it, it to enable all to communicate with one* another and to interact with information resources vital to teaching and learning from anyplace to anyplace at anytime.

At CSUMB, learning and teaching incorporate traditional classroom faculty performances (face-to-face) with video-taped lectures, streaming audio and video (this fall) , and interactive mulitimedia web pagers. Faculty create learning experiences that address the 13 University Learning Outcomes (ULR's) that have replace the traditional general education requirements of sixty plus units of credit. Students graduate when assessed as competent, not just because they completed 124 units. Major Learning Outcomes (MLO's)- our the requirements for a degree in a major. Some of our majors have been quite successful in moving curriculum content onto our network, making the information typically transmitted during a class lecture or lab accessible to the student independent of the class or professor who teaches it. Such courseware will ultimately allow our students to study independent of faculty members or even school schedules. The objective of the faculty planners was to create a "smart campus" from the ground up, rather than patching together the technologies into an existing architecture. To that extent, we have been very successful in creating a campus with an information infrastructure supporting widespread integration of technology into the educational process. CSUMB faculty and staff have multimedia workstations, and each student has assured access to a computer. As part of CSUMB's assured access policy, approximately 80 per cent of students bring a computer to campus with them, or buy one through one of CSUMB's attractive purchase/lease plans. Computer labs are available in the Library, Media Learning Center and dorms for students who do not have their own computers. Classrooms, labs, offices and residence halls are networked. Each student has an email account, at least 10 Mbytes of private server storage, access to Internet and an area for publishing electronically on World Wide Web. Electronic mail serves as the primary form of communication, scheduling, and document distribution mechanism. The ***FirstClass*** server (computer-mediated conferencing software) links students to each other via email and chat room to faculty, and to drop boxes for submission of course materials.

Our library has 15 full-time staff and regional and national access to on-line reference materials. Learners have access to more than 4,000 full text on-line journals through Lexis-Nexis, EBSCO, Masterfile, Expanded Academic ASAP, Business and Company ASAP, Academic Press IDEAL, Project MUSE, Novosoft, and World Wide Web publications. Students may also order journals and books from inter-library loan electronically. Linkages to partner libraries permit shared materials. The library staff have produced custom web browser interfaces to many databases, making access to information very intuitive. In fact, access is so simple, the author is concerned that students may not be able to use traditional libraries when they graduate from our campus Many faculty, encouraged by campus initiatives and tenure/promotion schemes are working to place their course syllabi and assignments on webservers. In fact, in the some departments faculty have converted their desktop machines to webservers for the express purpose of curriculum design and delivery. The day of the desktop educator has appeared! Work is distributed electronically via campus servers and handed in automatically into write-only drop folders via electronic mail. It is becoming routine for students to produce artwork, do research, submit assignments, make appointments, and create and perform class presentations, all by computer. They communicate among themselves and discuss work with their instructors on-line. They use collaborative document techniques to work together, use spreadsheets and charts to portray numerical information, and make multi-media portfolios used for the assessment of their work. They are skilled at using scanners, digital cameras, and projection equipment, and most can make Web pages. A server is dedicated to student work, and any student may create a home page and link it to CSUMB. Off course, this is not an electronic utopia.

Our studies show that the use of our campus network is varies dramatically when the ethnicity, gender and educational level of our students, aculty and staff. Universal access and use of our network has been a goal the we have not achieved. In fact, we are only beginning to understand the unintended impact of using our multimedia network to move curriculum to students. The effective use of the technology for teaching and learning varies widely from one major to another and there are remarkable differences between individual faculty in their ability to incorporate (much less embrace) the teaching philosophy promoted by DL and OBE. For students, barriers to using our network have been gender (women are less likely to use it) , length of exposure to computer technology (transferring students with no computer training suffer), and cultural factors that have not yet been examined and that we simply do not understand yet. Faculty barriers to access a two fold: 1) lack of training and exposure to multimedia networks has retarded the development of multimedia DL curriculum and 2) there are as yet no contracts defining faculty rights to the content they create or provide online Frankly, if a faculty member can make all of their "courses" (or learning experiences) available on-line, it means that ALL courses can be offered EVERY semester! The ramifications of this for calculating faculty load and full-time equivalency (FTE) are just now being examined.

Outcome Based Education at CSUMB

Outcome based assessment is not well understood by most faculty in the United States, for the simple reason that we were not exposed to it. As teachers, we tend to use the same techniques and philosophies that were used to train us. Most of today's educators were products of traditional schools that graduated us based on the credits we accumulated by taking classes, listening to lectures, and taking tests. The closest that most college professors came to OBE was the preparation of the thesis or dissertation. You may complete your cousework in graduate school, but without a thesis, you can not graduation. OBE separates course completion from the satisfaction of educational requirements. In other words, it is not time in a seat and the accumulation of units that leads to degree completion, it is the independent assessment of student competency. Most of our planning faculty understood this: many of us visited universities that were experimenting with OBE in their curriculum and in turn, we have been visited by them. New faculty did not have this exposure and even today there are many of our professors at CSUMB who do not understand what OBE is and may not be fully committed to it. OBE functions as follows at CSUMB.

Under the guidance and supervision of faculty, students are required to develop an Individual Learning Plan (ILP) that defines the *pathways* to achieve the 13 required university learning requirements (ULRs) and major learning outcomes (MLO's) Like many of our practices, this varies from Center to Center or major to major. However, the flexible learning principle is fairly ingrained in our campus culture, and it forces greater emphasis on the learning process. Faculty attention is focused on developing their courses with student learning outcomes central to curriculum content, presentation and specified deliverables. Because the MLO's and ULR's are defined by the university, courses (or other learning experiences) that do not provide content and deliverables addressing them are not helpful for a student to graduate. The original idea behind our outcomes based model was that students could learn on their own, with others, and through many different experiences rather than a fixed number of required courses. Although courses offered by faculty would be useful for assisting students to become competent, our objective was to provide many different pathways for learning students. Students would become "active learners" and the role of faculty would increasingly be that of assessor of student achievement, rather than content deliverer. Students would become less dependent on the information and learning assignments provided by faculty in class and more dependent on their own initiative and judgment as learners.

Technology was to play an important part in the empowerment of the learner as well as influence the role of the teacher-as-assessor. This is still a distinct possibility, but as a critical reviewer will see in the discussion that follows, traditional pressures for majors (called Centers and Institutes) to capture FTE in order to boost Center budgets, has resulted in a large number of Institutes that now *require courses* for graduation, intentionally derailing the original idea of allowing students to gain mastery from a body of learning modules or outcomes shared across disciplines, specified as part of their Individual Learning Plan.

Planning faculty (the first dozen hired to operationalize our learning outcomes) viewed competency assessment as central to OBE. The ULR's and MLO's were not to be centralized in any one "course" - as they currently are -- the learning outcomes were to be embedded throughout the curriculum in a cross disciplinary fashion. Early proposals were for curriculum modules (computer assisted learning - CAL) to be developed by faculty - or purchased out right by the university from commercial firms - that addressed the ULRs. Such modules -- or faculty sponsored learning experiences -- would allow students to develop products that could be assessed *independent of the faculty who facilitated the students learning*. In removing assessment from the faculty member, we believed that we could end social promotion, grade inflation, and identify poor teachers. This has turned out to be one of the most controversial aspects of our teaching philosophy. Our original vision of assessment independent of faculty still exists, but competes weakly against faculty sponsored ULR Committees that have developed a procedure for approving class syllabi that are said to address the ULR's. For most students on our campus, they need only take a class and get a passing grade (C-) which the ULR Committee has *officially approved as meeting the ULR* . In summary, for the most part, students now take classes, must get passing grades, and faculty do the assessment. By requiring a fixed set of classes within a major (in the funding battle for FTE) not only have we moved away from a true OBE model, we are closing the door on transdisciplinary learning.

In this authors view, true OBE puts the emphasis on the student's demonstration of what s/he knows and is able to do, not on completing a pre-determined set of courses. The CSUMB model - as we originally envisioned it - required that professors state in advance of instruction the learning outcomes students were expected to achieve (as a result of their teaching) and it required that students understand that they must demonstrate proficiencies associated with those outcomes independent of college units and classes in order to graduate. Our website describes the required ULR's as "…(the system) works a little bit like getting your driver's license. To get a driver's license, you need to demonstrate that you know how to drive and that you know the rules of the road. You can learn these things in a variety of ways, for example, taking private lessons, doing trial and error, or some combination. When you do get your license, you are not held accountable for how you learned to drive, but rather for demonstrating that you are able to drive "(http://www.monterey.edu/academic/ulr). We operationalized the University Learning Requirements as 13 ULR's and each major operationalized their own specialized learning requirements as Major Learning Outcomes (MLO) - sometimes called ULO's and MLO's (where the "O" stands for outcomes). The 12 ULR's are: Community Participation, Creative Arts and Expression, Culture and Equity, Democratic Participation, English Communication, Ethics, Language, Literature and Popular Culture, Mathematics Communication, Science, Technology/Information, United States History, and Vibrancy. It is beyond the scope of a paper this size to address the evolution of each of our MLOs. However, four of the ULR's deserve critical review because unlike the other nine, these four are required for *all* students at the university, including transferring juniors. Three of those four will be addressed in this paper. The additional nine are required of those that enroll as freshmen or sophomores, as a replacement for the general education requirements at traditional CSU's. These four are: **Technology and Information**, **Foreign Language**, **Service Learning** and **Culture and Equity**. These "special status" ULR's require the closest evaluation and will serve as examples for how CSUMB has operationalized OBE within the DL environment. To satisfy a ULR or MLO, a student must write and proposing an Independent Learning Plan (ILP that selects one of the following three pathways for fulfilling the ULRs.

1. If a student does not already possess the knowledge and skills required by a ULR or MLO, then the student can register for one of the courses which have formally been designated as offering preparation and assessment for that ULR, and the student will be assessed by the instructor(s) right in the course.

2. If the student does not already possess the required knowledge and skills, but he or she has a plan to gain the required knowledge in some way other than taking one of the designated courses, then the student should work out that plan with her or his advisor. After the student has gained the required knowledge through this alternative means, then the student would register for an independent assessment of that ULR.

3. If the student believes that he or she already possess the knowledge and skills contained in a particular ULR, then the student should register for the appropriate independent assessment (ASMT) for that ULR. After registering for the ASMT section corresponding to the ULR, then the student should see the chair of that ULR Committee for instructions on how to prepare for the independent assessment. (see: http://www.monterey.edu/academic/ulr)

The Technology and Information ULR- One Example

The requirements for this ULR are as follows:

Students must demonstrate comfort with technology and information search and discovery methods. Demonstrate the ability to use tools effectively for the discovery, acquisition, and evaluation of information as well as core computer tools for the manipulation and presentation of information in a creative and ethical manner. Students will demonstrate ability to: 1.use their computers to create, edit and produce attractive documents which conform to a set of given standards. 2.produce a clear, cogent representation of tabular data.3.create a what if analysis on a set of quantitative data, using a spreadsheet. 4.create a pictorial representation of a set of data, using charting or graphing software. 5.successfully use a variety of information resourcesand information search and discovery systems, such as the CSUMB Online Library Catalog, as well as citation, abstract, full-text databases, and the Internet. 6.understand the scholarly publication process and distinguish popular from scholarly treatments and primary from secondary resources. 7.effectively attribute sources according to existing standards and use software tools for the maintenance and construction of bibliographic information. 8.evaluate information by referring to indicators of quality and accuracy. 9.create an aesthetic electronic presentation which includes images and data. 10.participate in the CSUMB electronic community. This includes the computing environment, including servers, electronic conferences, and electronic mail. 11.use computers in the creation of an artistic product. 12. demonstrate an understanding of "netiquette", intellectual property/copyright, and of ethical use of technological tools.

The success of the Technology ULR curriculum can be understood when we see how it was created. Consultants (later to become part time faculty or staff) developed this curriculum under contract. The curriculum was originally treated as public domain, but has recently been treated in a more proprietary manner. Developed under contract, the curriculum is not owned any single faculty member, thus part-time faculty are typically hired to administer it, at great savings to the university. As you might imagine, this model of OBE sets the stage for an institution is primarily composed of part time faculty, and indeed CSUMB is currently staffed at over 60% part time with the lowest number of tenured faculty in the CSU system! It is obvious to many of us that when we allow curriculum to be own by the university so that students can achieve learning outcomes independent of a faculty member, assessment becomes the primary activity of a teacher, not pedagogy!

Operationalizing the performance criteria of the Tec ULR was not a highly political process, given that the outcomes were for the most standard computer applications well understood by industry as relevant to the modern electronic office. The infusion of technology into much of our pedagogy as well as the culture of the institution has lead many students to choose assessment, rather than a class, for demonstrating competency. In summary, the Technology and Information ULR is our best example of independent competency assessment, fully operationalized and described on the supporting university web site. The outcome has been easy to operationalize. Technology tutorials are readily available online and owned by the university, not faculty. Students are increasingly fulfilling this requirement by assessment.

Service Learning and Culture and Equity: A Second Example

Where the Tec ULR may be viewed as a relatively noncontroversial set of learning outcomes, Service Learning and Culture and Equity share the common characteristic that students must demonstrate an implicit set of *values* as *well as content master*-y. When we assess for Learning Outcomes that require students to demonstrate normative (non-academic) values, we engage in a highly controversial area of education. . Within these two ULR's, " college literacy" has been defined to include the demonstration of approved values and social behaviors such as volunteerism for Community Participation and demonstrating a "commitment to work for social equity" in C&E These values are deemed as necessary for students to be "literate citizens in a multicultural, global society" and represent perhaps the most controversial aspect of our learning requirements.

Service Learning has proven itself to function usefully in the curriculum. For the past three years the ULR has not been well understood - many faculty asked the question, "how is volunteerism expected to contribute to student literacy"? Outcomes in service learning have been operationalized as a) **Civic Participation and Self Efficacy)**, b) **Career Preparedness** and c) **Academic Relevance**. These outcomes are assessed by the application of the Student Service Assessment Questionnaire. Pre-testing and post-testing of students with the "service learning scale" have demonstrated that students (after the SL experience) see contributing to the community as more important than before the experience and believe themselves to be more comfortable in such situations. They claim to be more prepared for the world of work, and their motivation to enroll in classes that have "real-life" applications and "hands on experience" (Service Learning Research Student, January 1999). On our campus, the Service Learning Outcome appears to be functioning quite well in the role of a traditional internship- that is to say, it provides "on the job training (OJT)" that is especially relevant to our younger students. Never-the-less, older students have been known to find this upper division requirement irrelevant to their study and seek alternative assessment based on life time experiences.

What We Have Learned- Recommendations

There are two points that one might conclude from the above discussion. First, CSUMB found it difficult in its search for faculty with sufficient pedagogical experience with multimedia teaching tools and OBE. Over 6,000 resumes were screened for the first appointments of thirty or so teaching faculty. We discovered that of those hired, few could actually meet the 13 ULRs proposed by the planning faculty! Traditional universities require faculty with advanced degrees, not competencies and our selection process netted well qualified traditional academicians. Thus faculty have needed extra time for course preparation, faced with learning to manage multimedia software and students with flexible learning plans. Faculty loads have not reflected the planning and development component of faculty teaching, and overwork has been the result.

Secondly, the ULR Committee structure, which was originally developed as an organizational strategy to promote interdisciplinary study in an OBE environment has slowly recreated the traditional "graduation by taking a course" framework we are all familiar with. Those committees now approve syllabi as meeting MLO's, thus getting a C- in a class fulfills a graduation competency. Centers seek to bolster FTE by requiring courses "within the major" to fulfill MLO's and students can not author ILP's that are transdisciplinary. In contrast, the CSU Chancellors office in its support for OBE, rejects course based assessment in favor of coverall program outcomes, stating that "Each university will strengthen baccalaureate education through student learning outcomes and assessment…Each university will identify student learning outcomes for both General Education and degree program majors, focusing on the outcomes of overall programs rather than individual courses (Cornerstones Report, p. 1). With such a mandate, the CSUMB leadership will soon need to address MLO Committees that are restructuring our vision of OBE to that of a more traditional CSU.

An extended version of this paper with full text of all citations and links is located at the author's website.

IMAGO - Web Based Mapping Solution for Business Processes Modelling

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Abstract: This paper describes the experience gained by the Telecom Italia Network Direction with IMAGO (the Italian acronym for Multilevel Interface for Graphic Organizational Analysis), an application designed to ensure that knowledge about the organizational structure of operation processes and how they evolve can be put to profitable use at all levels. The IMAGO application's objective is to build up a "Process Library" to represent operation processes uniformly and with various levels of detail, to disseminate these processes promptly throughout the company's Intranet, and to monitor how management of each process evolves over time. Users may choice, in a dynamic way, different kind of graphical representation and have a "real-time" data adjustment. The maps are visualised through Autodesk MapGuide software, this is one complete solution to build, deploy, and access intelligent, map-driven Web sites.

1. Introduction and Motivation

The IMAGO application's objective is to build up a "Process Library" for the Telecom Italia Network Direction so that possible or plausible relationships that now govern the workflow of the activities for which the Direction is responsible or will govern it in the future can be identified.

The IMAGO application is designed to satisfy a range of needs: to represent operation processes uniformly and with various levels of detail, to disseminate these processes promptly throughout the company, and to monitor how management of each process evolves over time.

With the complexity of the operation process maps it is thought to consider them as one of the cartographic maps, and to search through the GIS tools a solution to supply dynamic and interactive maps to the IMAGO's users. In IMAGO, it's been inserted the Autodesk MapGuide suite. Autodesk MapGuide software is a complete solution comprised of all the tools to build, deploy, and access intelligent, map-driven Web sites.

2. IMAGO Methodology

IMAGO provides a methodological support for business process analysis and allows model's description and representation. To guarantee that the description of operation processes satisfies the company's quality targets and business needs, it is particularly effective to be able to use a uniform methodology for analysing and representing the processes.

The methodology shall use *an information representation standard*, which employs formal notation in order to reduce the risk of ambiguity, inaccuracies or incompleteness in the description of operation processes.

The purpose of a business model defined through IMAGO is to represent all or part of the Network Direction's operation processes and to highlight the functional and control aspects and the relationships between the processes themselves and the corporate dimensions (Services, Organisation, Technologies, Systems and Standards).

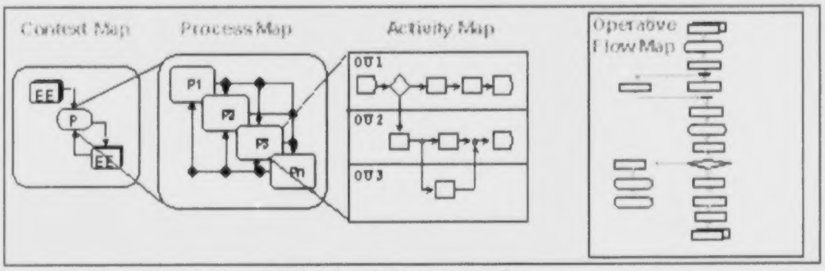

Figure 1: Different type of maps

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The IMAGO methodology consists of different phases from which:

- ***Processes functional analysis***: consists in capturing the basic aspects of the processes to identify both functional components and information flows among them; a multilevel model (Process's Maps) is built through iterative specialisation steps.
- ***Activities control property analysis***: processes that make up the last representation level of the functional analysis are specialised in activities. The outcome of this phase portrays a most specialised description of the model, and catches on the process's control and behaviour aspects. The ensuing model (Activity's Maps) is built on more levels through iterative specialisation steps.
- ***Company Co-ordinate application***: aimed to define relationships between processes or activities and the corporate dimensions: organisation, information systems, services, technologies, norms, etc…
- ***Operative flows definition***: they are processes and/or activities sequences, which are event driven, and time dependent.

3. IMAGO Tools

IMAGO provides a family of tools to editing, managing, publishing and consulting the diagrams of activities, processes, operative flows and the organisation chart:

- **IMAGO Modelling**: to represent the company's business processes, showing its functional and control issues and relationships among processes and other corporate dimensions: organisation, information systems, services, technologies, standards, etc ... The Library for all this information can be of any standard RDBMS. Each team member can work on his or her piece of the project free from fear of clashes. With IMAGO Library, they can all work on the same project, using the methodology that works for the piece they're interested in.
- **IMAGO Web-Publisher**: is used for publishing all the information from IMAGO Library to IMAGO Web. The site structure is completely configurable.
- **IMAGO Web**: much more than a set of HTML pages, the site generated by IMAGO Web-Publisher makes it possible to consult the information contained in the Library dynamically on the Web and contains dynamic links between all the elements, even the maps.
- **IMAGO Feedback**: an IMAGO reader can send a feedback or a message to the process owners.

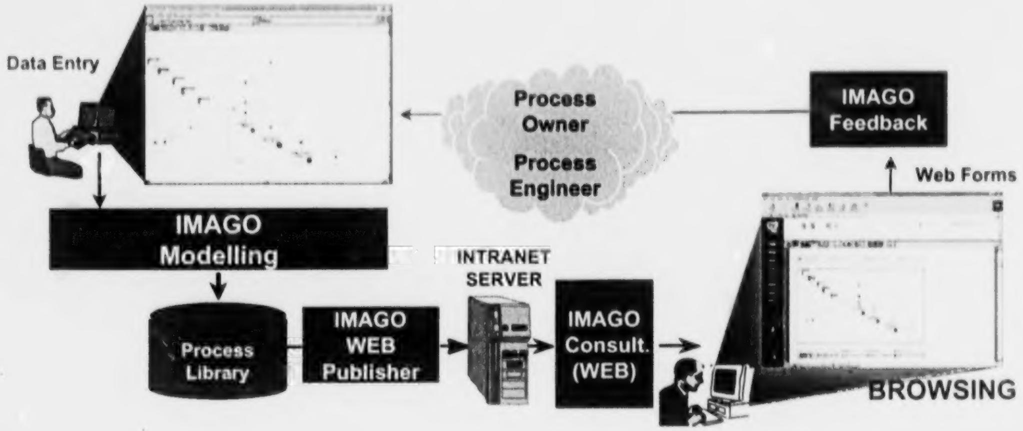

Figure 2: IMAGO Tools

An IMAGO Reader must easily individuate the operative flows in which it occupy's, through out selection filters on the company co-ordinates (e.g. setting his organisation unit). When it visualises the operative flow map, an IMAGO Reader must easily individuate the activities in which it occupy's. An operative flow can involve more than one hundred activities and different organisation units. So the operative flow map can result in great dimensions. It is necessary to have the functionality of zooming and panning. Also it is necessary to have a mechanism to point out the activities been relational with a particular company co-ordinated. Each activity must be selectable to be able to ask for the relative description form.

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With the complexity of the operative flow maps it is thought to consider them as one of the cartographic maps, and to search through the GIS tools a solution to supply dynamic and interactive maps to the IMAGO's Readers. In IMAGO, it's been inserted the Autodesk MapGuide suite. Autodesk MapGuide software is a complete solution comprised of all the tools to build, deploy, and access intelligent, map-driven Web sites. It delivers live maps and linked databases directly to your desktop, via Intranet or the Internet.

Within a browser , it is possible from each office equipment (PC), to surf on dynamic data using tools, bottons, query (with bullets selection) and properties. IMAGO Readers may choice, in a dynamic way, different kind of graphical representation and have a "real-time" data adjustment.

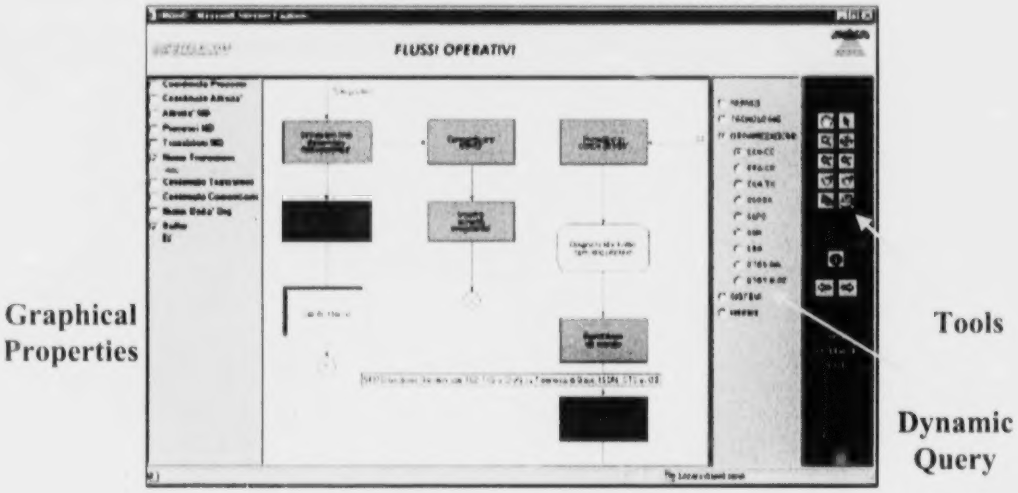

Figure 3: An example on graphical data navigation using an enterprise internet browser.

4. How Autodesk MapGuide Products Work Together

Autodesk MapGuide software is a complete solution, comprised of all the tools to build, deploy, and access intelligent, map-driven Web sites. The three main components are MapGuide Viewer, Author and Server.

Autodesk MapGuide Author stores maps as map window files (MWF). Each MWF file contains the specifications of the map window, including map extents, background color, data source information (SQL databases, spatial data files, and raster image files), layers of cartographic data (such as roads and countries), layer display information (such as attributes and visible scales), and map display configuration specifications (such as menus and legends).

To create a map, you use Autodesk MapGuide Author to combine resource data, such as spatial data (spatial data files and raster image files) and attribute data (SQL databases) into maps. The maps you publish using Autodesk MapGuide Author are saved as map window files (MWFs), which contain the complete specifications of the published map, including the boundaries of the map, background color, layers of cartographic data (such as roads and countries), layer display information (such as attributes and visible scales), and map display configuration specifications (such as menus and legends).

Autodesk MapGuide Author supports four types of vector map layers: point, text, polyline, and polygon. Each layer contains only one type of map object. You can create a layer and use it for a specific map, or save it as a separate map layer file (MLF) and use it in several different maps. A map can contain multiple layers of the same type, each of which can be set up independently of the others. Map layers are created from spatial data files (SDFs) or SQL databases. Layers created from SDF files can be linked to SQL database tables, allowing you to display data using display themes. For map layers built from an SQL data source, or SDF files linked to an SQL data source, specifies a valid SQL Where clause to restrict the map objects displayed on the map layer. The Where clause typically references a column from the Object Table.

Autodesk MapGuide Author draws layers in order of increasing priority. For instance, the program draws the layer with priority 0 first, then draws the layer with priority 1 next, on top of layer priority 0, and so on.

The end user who wants to view the published maps installs the Autodesk MapGuide viewer. The user's Web browser can then recognise the registered MWF file type as a map window file, so that when the user opens an

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HTML page that contains an MWF file or clicks on a link to an MWF file, the Web browser automatically loads the Autodesk MapGuide viewer to display the map. The viewer reads the MWF file and displays the map according to the settings specified in Autodesk MapGuide Author. Whenever you use either Autodesk MapGuide Author to create a map or the Autodesk MapGuide viewer to view a map, a request is made to Autodesk MapGuide Server, which then provides the resource data in that map via the Internet, an intranet, or an extranet using the services of a Web server and a Web browser.

The Autodesk MapGuide Server software consists of three components:

- The Autodesk MapGuide Server Agent receives requests for map data from Autodesk MapGuide Author or the Autodesk MapGuide viewer via a Web server. The Agent queues the requests as they are received and distributes them to the Autodesk MapGuide map server.
- The Autodesk MapGuide map server receives and processes the requests for map data distributed by the Agent, formatting the data as requested by the map layer, and then sending the data back across the Web to Autodesk MapGuide Author or the viewer.
- The Autodesk MapGuide Server Admin gives you complete operational control over Autodesk MapGuide Server, allowing you to configure resource security, log file generation, data source directories and database access, integration with the HTTP server, and service start/stop.

Autodesk MapGuide Server is a scalable, fault-tolerant, 32-bit, multi-threaded software application that provides authored map data in response to requests from the Autodesk MapGuide viewer and Autodesk MapGuide Author. Using Netscape ® NSAPI interface to integrate with Netscape Web servers, the Microsoft ® ISAPI interface to integrate with Microsoft Web servers, or the standard CGI interface, the Autodesk MapGuide Server Agent can support an unlimited number of map servers by using remote procedure calls (RPCs). Autodesk MapGuide Server supports simultaneous connections to multiple geographic files and multiple relational databases resident either locally or under operating systems on workstations accessible on the network.

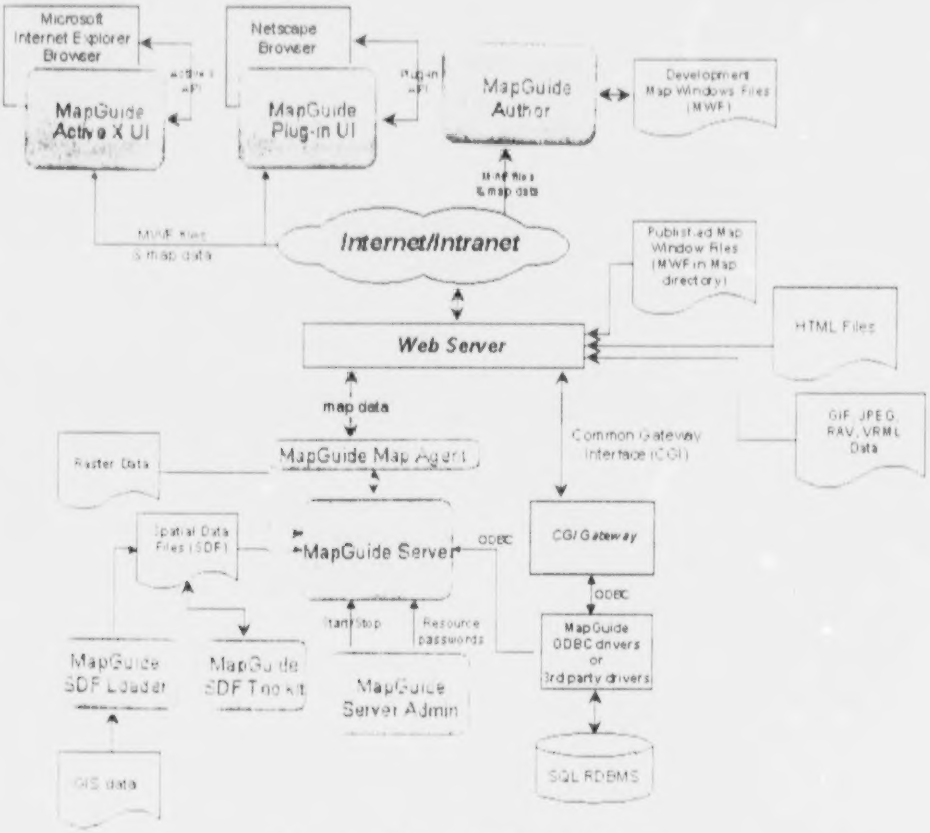
Microsoft Internet Explorer Browser
Netscape Browser
Active X API
Plug-in API
MapGuide Active X UI
MapGuide Plug-in UI
MapGuide Author
Development Map Windows Files (MWF)
MWF files & map data
MWF files & map data
Internet/Intranet
Published Map Window Files (MWF in Map directory)
HTML Files
Web Server
map data
GIF, JPEG, RAV, VRML Data
Common Gateway Interface (CGI)
Raster Data
MapGuide Map Agent
Spatial Data Files (SDF)
MapGuide Server
ODBC
CGI Gateway
ODBC
Start/Stop
Resource passwords
MapGuide ODBC drivers or 3rd party drivers
MapGuide SDF Loader
MapGuide SDF Toolkit
MapGuide Server Admin
GIS data
SQL RDBMS

Figure 4: Autodesk MapGuide architecture

5. How IMAGO Server works

SDF files contain map objects, which are drawing objects such as points, polylines, and polygons that represent physical features on the map. SDF files can also contain polypolylines (multiple polylines grouped as a single map object), and polypolygons (multiple polygons grouped as a single map object).
Each object definition describes the type of object, its name, unique key, and the number of points that are required to describe the object. Each of the points must be in latitude/longitude coordinates.

```
<ObjType>, <ObjName>, <ObjKey> [, <URLLink>], <NumPts>
<LatitudeValue1>, <LongitudeValue1>
...<LatitudeValueN>, <LongitudeValueN>
```

Each map object has a unique key (a string of characters that identifies the map object), which allows the map object to be linked to attribute data in a database. Each map object may also have an associated URL.

To use the data from an SDF file in a map, you use Autodesk MapGuide Author to link the SDF files to layers in an MWF file. Layers are like transparencies that, when overlaid, display as a single picture. Each layer displays one type of map objects only (points, lines, or polygons). The end user views the MWF files with the Autodesk MapGuide viewer, which sends requests to Autodesk MapGuide Server to provide the data from the SDFs.

In IMAGO for every type of map (context, processes, activities, operative flows and organisation) a MWF file is created. For every type of object that can be inserted into a map it has been defined one or more MLF file with the relative SDF file.

During the IMAGO Web Publisher publication for each object present in the map there is a record insertion in the relative SDF file setting the unique key ObjKey="*<MapID>-<ObjID>*", where MapID and ObjID are the identifiers of the relative map and object in IMAGO Repository.

Every SDF file is linked with an appropriate IMAGO Repository table. This link is used during the consultation of the maps to visualise only the objects of the requested map. In fact when a reader asks for a map the relative MWF file is loaded and all the layers are set with the clause Where="ObjKey like '<MapID>-*' ", where MapID is the identifier of the requested map.

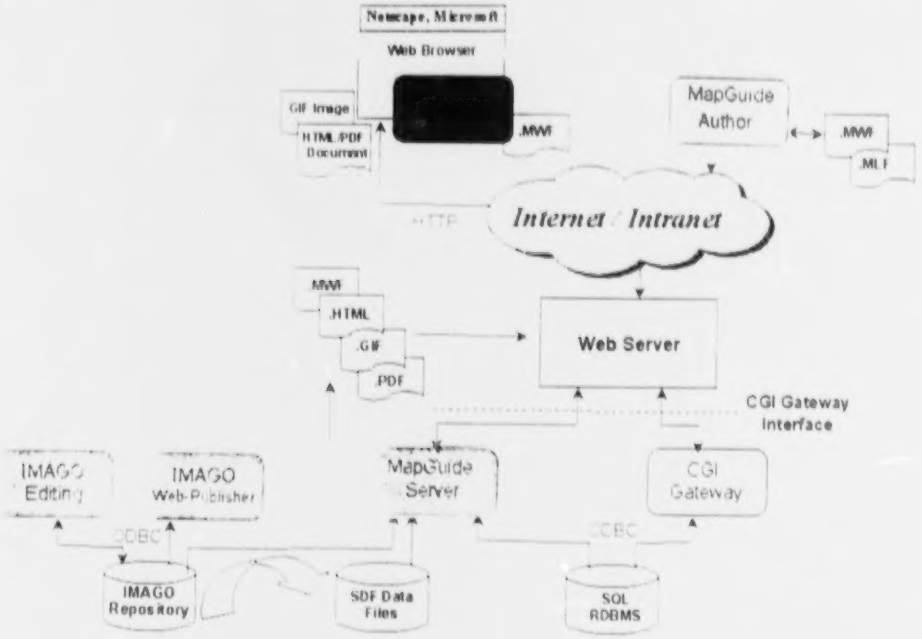
Netscape, Microsoft
Web Browser
GIF Image
HTML/PDF Document
.MWF
MapGuide Author
.MWF
.MLF
HTTP
Internet / Intranet
.MWF
.HTML
.GIF
.PDF
Web Server
CGI Gateway Interface
IMAGO Editing
IMAGO Web-Publisher
MapGuide Server
CGI Gateway
ODBC
ODBC
IMAGO Repository
SDF Data Files
SQL RDBMS

Figure 5: IMAGO architecture

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6. Conclusions

It was shown that the design and the consultation of large operation processes have special needs requiring new concepts. The IMAGO project provides some powerful new ideas. It is an approach to editing, managing, publishing and consulting the diagrams of activities, processes, operative flows and the organisation chart. In Telecom Italia Network Direction many operation processes have been modelled successfully. We are currently re-engineering IMAGO Tools to improving the features.

7. References

[AMG] "Autodesk MapGuide", http://www.autodesk.com.

[BEL93] Bellucci A., De Maio A., Mutti R., "Organizzare per Processi", Sviluppo e Organizzazione, Marzo-Aprile, 1993.

[DAV93] Davenport T.H., "Process Innovation: Reengineering Work Through Information Technology", Harward Business School Press, 1993.

[HAM93] Hammer M., Champy J., "Reengineering the corporation – a manifesto for business revolution", HarperCollins Publishers Inc., 1993.

[HAM96] Hammer M., "Beyond Reengineering: How the Process-Centered Organization is Changing our Work and our Lives", HarperCollins Publishers Inc., 1996.

A Study of Asynchronous and Synchronous Discussion on Cognitive Maps in a Distributed Learning Environment

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Abstract: A comparative study of use of asynchronous (bulletin board) and synchronous (chat) for discussion on three learning units based on the cognitive maps developed by the learners has been made. We have found that cognitive maps could be an effective tool for learners for discussion in a distributed learning environment. Cognitive maps provided learners to organize their understanding of the learning units. During the discussion session on the Internet the learners were able to exchange their ideas based on the cognitive maps. After the discussion learners modified their cognitive maps with regard to newer understanding of the text. The learners have preferred bulletin board as a discussion platform as it gave them better opportunity to concretize their thought before responding to the collaborating group members.

1. Introduction

There is a strong movement in education today toward a learner-centered model where the learning activities involve students in inquiry and problem solving, typically in a collaborative framework [Duffy, Dueber & Hawley 1997]. We are confident that a highly interactive, learner-centered environment is a worthy goal in higher education and training environment in terms of quality of the learning experience [Austin 1993; Johnson & Johnson 1993]. Interaction is valued as a vehicle for developing metacognitive, critical thinking and reflective thinking skills. In one of his recent publications David Jonassen [Jonassen 1996] explores collaboration as a function of knowledge construction.

Problem based learning (PBL) is perhaps the most widely applied approach to teaching in which the focus of learners' activity is collaborative inquiry and the teacher is a facilitator. We are presently involved in the development of a WWW based system for PBL [Madhumita & Akahori 1998]. We plan to implement bulletin board for on-line and off-line discussion among the members of a group. We also intend to introduce development of cognitive maps by individuals based on their understanding of various concepts and their relations during the self-study. Cognitive mapping is a process for representing concepts and their relationships in graphical form, providing teachers and students with a visually reach way to organize and communicate what they know. Use of cognitive maps during discussion sessions helps in focussing the discussion.

Cognitive maps or concept maps provide a flexible format for graphic representation of concepts and the relationships among them [Jonassen, Beissner & Yacci 1993; Novak & Gowin 1984]. Cognitive maps are hierarchical representations of concepts and propositions that reflect both the content and the structure of a person's knowledge in a given domain. We know that the knowledge content and structure may be different for different people (or change over time for the same person), cognitive maps may help us communicate with each other about what we know or think we know. Visual organizers, in general, can be defined as graphic representations of different kinds of thinking processes [Clarke 1991]. Cognitive maps are a form of visual organizer that, as Clarke has pointed out, supports both inductive and deductive thinking.

In the present experiments the learners summarized the given text material in the form of cognitive maps. In the process of summarization learners must read and understand new information and then transform that information in the form of a cognitive map. Cognitive mappings have been used as a visual organizing technique and were used as a tool for discussion.

2. The Study

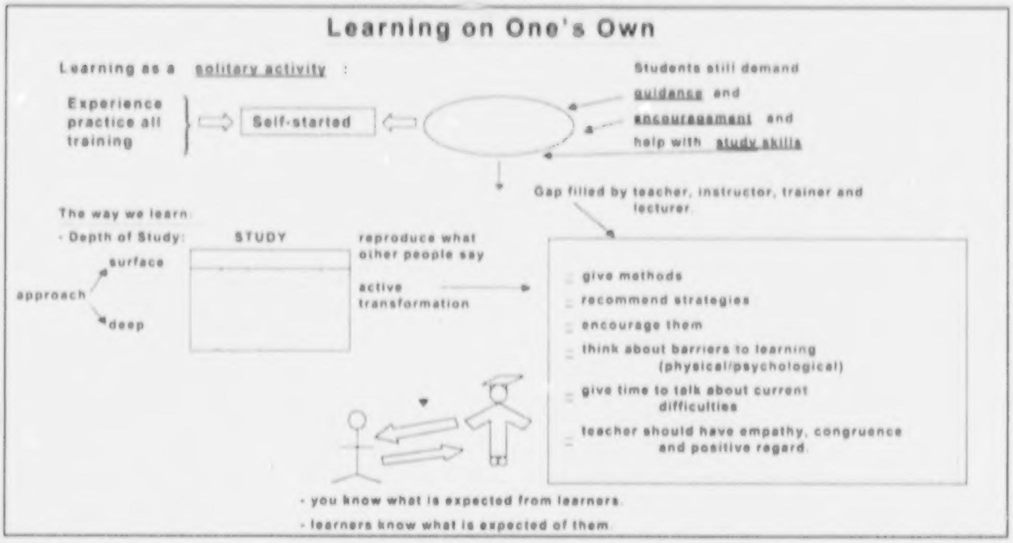
The present experiment consists of three steps: 1. Construction of an initial cognitive map based on ones own understanding of the given text material and his/her previous knowledge regarding the concepts in the text, 2. Holding the discussion session using bulletin board and chat facilities over the Internet with the other group members and the teacher and 3. Refining the cognitive maps based on the newer understanding of the concepts.

Fifteen members from different organizations and institutions from different parts of the world have participated in the experiments. Most of the participants were professionals, mostly engineers, therefore, their background knowledge about different aspect of " The Theory of Learning" were same. The three articles chosen for the experiments were: Motivation and Goal Clarity, Learning on One's Own and The Role of Language in Learning. The subjects were suppose to read the given text material on "The Theory of Learning " [Cotton 1995], understand it and develop a cognitive map based on their understanding of the text. The cognitive maps were conceived and produced first on paper and then they were converted into Word or Power Point files. After completion of the individual cognitive maps these maps were sent to the author by fax or as email attachment. These cognitive maps were then delivered to each member of a group half an hour before the discussion session by using fax, as email attachment or as URL.

The subjects participated in the discussion session through the World Wide Web. There were six groups having three and two members using bulletin board and Internet chat respectively. One article was assigned to five participants where three of them discussed their cognitive maps using bulletin board and two used chat. In the discussion session subjects used nicknames in order to keep their original identity hidden such as name, sex and nationality.

The author (nickname: Mita) participated as the moderator in the discussion session. The cognitive maps were considered one by one for discussion in each group. Subjects were asked to explain certain features of their maps. The subjects concentrated on every aspect of a map. They discussed about the individual opinion of the collaborating partners on the given text material.

On an average discussion session lasted for one hour. The discussion took place by using Internet chat and bulletin board developed by the author. Excerpts from the discussion sessions using two different ways have been placed in figure 1 and 2. In order to make the discussions understandable, the cognitive maps produced by Celia and Sakura are given before [Fig. 1] and [Fig. 2] respectively.


Learning on One's Own
Learning as a solitary activity :
Experience practice all training
Self-started
Students still demand guidance and encouragement and help with study skills
Gap filled by teacher, instructor, trainer and lecturer.
The way we learn:
- Depth of Study:
STUDY
surface
approach
deep
reproduce what other people say
active transformation
give methods
recommend strategies
encourage them
think about barriers to learning (physical/psychological)
give time to talk about current difficulties
teacher should have empathy, congruence and positive regard.
- you know what is expected from learners.
- learners know what is expected of them.

Celia's Cognitive Map: Learning on One's Own

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***Ruth**: while the article's title is learning on one's own, I think the author really didn' suggest any tips or ways to study on one's own.*

mita: I am thinking about the Celia's map I would like to ask on what she meant by two different human figure

mita: celia do you agree with ruth that the article does not give any tips on learning on your own

Celia: about the figures, one is the leaner and the other the teacher, there is an inter-relation, a feed back between

***Ruth**: For e.g., even in his tips to the instructors he says that either friends or groups are needed to learn. Recall "learning-to-learn work shop" in the text*

mita: Actually this text is for teachers who should prepare the students for learning on their own this is my observation

***Ruth**: Mita! I think you are correct*

Celia: One question, do you think these guidelines can be applied in learning at any level? I mean, university, high school, primary school?

mita: Celia in your fig. active transformation and gap filled by teacher etc the arrows pointing to the same box could you through some light on the same

mita: According to me this guidelines could be applied definitely in high school and higher education and with little modifications in primary education

mita: the last two sentences in your diagram convey something

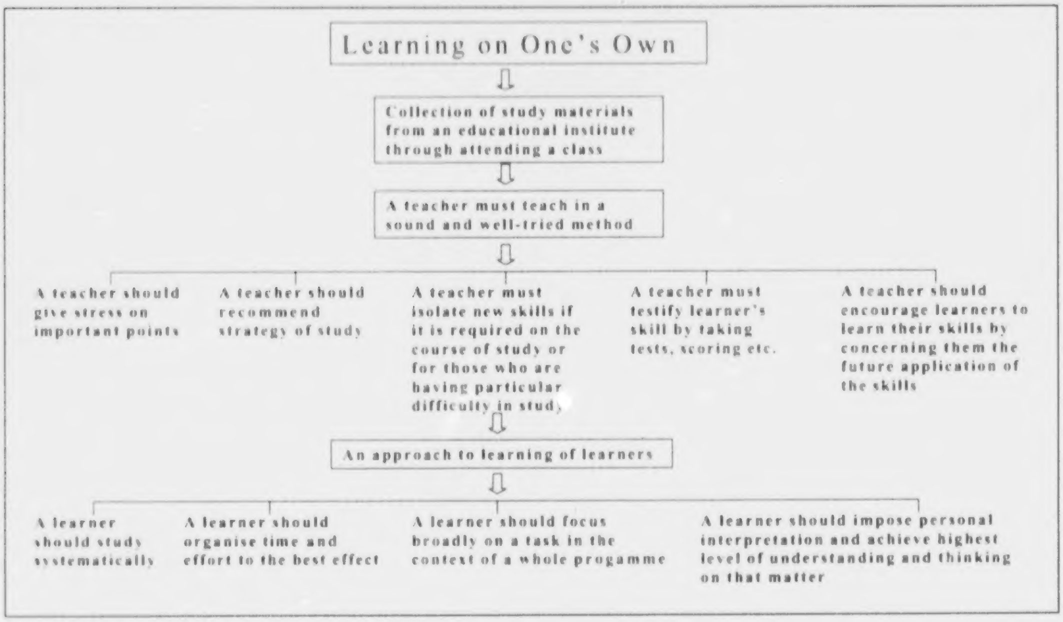
***Ruth**: I thought these guide lines would be useful at higher levels, I mean in college or universities rather at primary and high school level*

mita: yes definitely these are very useful for adult learners

mita: Celia some thing about last two sentences please

Celia: active transformation I think it is talking about the Piagetian words about assimilation and accommodation, what is necessary for learning from the learner and the square is indicating what the teacher can do, then it comes the relation between then. The two lines at the end are pointing that learning by one's own is not a solitary activity, it can't be so.

Figure 1: Excerpts from Discussion Session (using chat)


Learning on One's Own
Collection of study materials from an educational institute through attending a class
A teacher must teach in a sound and well-tried method
A teacher should give stress on important points
A teacher should recommend strategy of study
A teacher must isolate new skills if it is required on the course of study or for those who are having particular difficulty in study
A teacher must testify learner's skill by taking tests, scoring etc.
A teacher should encourage learners to learn their skills by concerning them the future application of the skills
An approach to learning of learners
A learner should study systematically
A learner should organise time and effort to the best effect
A learner should focus broadly on a task in the context of a whole progamme
A learner should impose personal interpretation and achieve highest level of understanding and thinking on that matter

Sakura's Cognitive Map: Learning on One's Own

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Hi members!
I must congratulate Sakura for making a lively pictorial presentation for the concept map.
I would like to make the following comments.
M1 I think after the 1st block one block should come. This block should tell the aim and objective because the learner should know what to study and to which extent(i.e., whether surface or deep approach in a time frame manner).
M2 The 3rd block should be little changed. Since this is a topic for Learning on One's own, the teacher need not to spoon-feed. Teacher should help only when the student request him/her to do so i.e. they need some guidance.
Merry

Hi Merry
your 1st comment on objectives is really valid because otherwise students are confused. Sakura has logged in she will contact soon. I am extremenly sorry for the delay. I suppose learning on one's own could be successful if the approach is always deep otherwise strategic study is only for scoring marks.
Yes we call pro active (spoon feeding) and reactive (when desired by student) there are two categories. So teacher should be facilatator
Mita

Hi members!
Thank you very much for your clear pictorial view. Here I would like to answer regarding your points, these are as follows:
(1)Yes, the learner must have a particular aim and objective. The approach should not be superficial way, that is why I mentioned highest level of understanding and thinking should be achieved by the learner.
(2)Yes, learning by oneself should not be spoon-fed. But here by the strategy of study, I wanted to mean the proper way of collecting study materials (e.g. compiled brochure for proper library use should be given, important and interesting points on subject should be given to students for clear understanding)
Thank you very much for pointing out for the missing points.
regards,
sakura

Figure 2: Excerpts from Discussion Session (using bulletin board)

Participants using chat found it difficult to respond quickly as they got less time to think before responding. They were feeling some kind of mental pressure to respond immediately and so their responses were not involving much thought. The participants in the chat sessions were unable to gather comments and ideas in order to provide quick response. Therefore, the mental stress was accumulating.

After the discussions the participants modified their cognitive maps based on the newer understanding of the concepts particularly they modified the links among various concepts and added the missing concepts and links. An example of a before discussion cognitive map and after discussion cognitive maps are given in [Fig. 3] and [Fig. 4] respectively produced by the participant (nickname:Yang.)

At the end of the experiment the participants responded to a questionnaire. The responses to the questionnaire revealed that the participants liked the use of cognitive maps for discussion. They were able to focus and think critically with the help of the cognitive maps. Participants preferred the use of bulletin board as compared to Internet chat. They found that the quality of discussions are not very good in case of chat as participants hardly got time to think critically in order to respond.

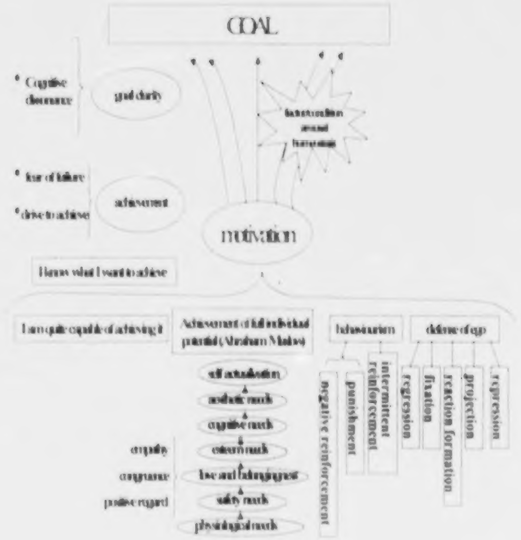
GOAL
Cognitive dissonance
goal clarity
fear of failure
drive to achieve
achievement
motivation
I know what I want to achieve
I am quite capable of achieving it
Achievement of full individual potential (Abraham Maslow)
behaviourism
defence of ego
self actualisation
aesthetic needs
cognitive needs
esteem needs
love and belongingness
safety needs
physiological needs
empathy
congruence
positive regard
negative reinforcement
punishment
intermittent reinforcement
regression
fixation
reaction formation
projection
repression

Figure 3: Before Discussion Cognitive Map (based only on Self-Study)

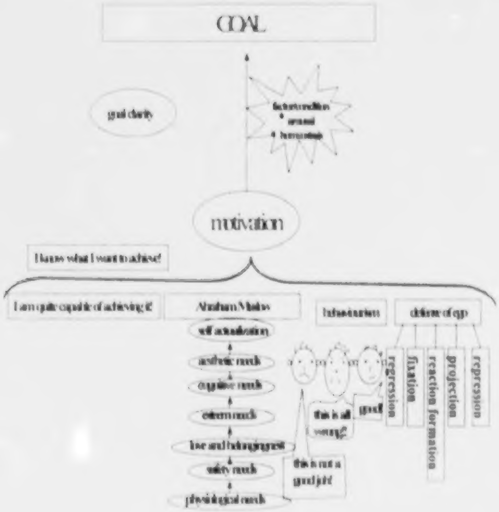
GOAL
goal clarity
motivation
I know what I want to achieve!
I am quite capable of achieving it!
Abraham Maslow
behaviourism
defence of ego
self actualisation
aesthetic needs
cognitive needs
esteem needs
love and belongingness
safety needs
physiological needs
this is all wrong!
good!
this is not a good job!
regression
fixation
reaction formation
projection
repression

Figure 4: After Discussion Cognitive Map (modified based on the disicission)

3. Discussion

In the exercise all the participants produced the cognitive maps based on their understanding of the given text material before the discussion session and all of them modified the maps after the discussion. All the subjects participated sincerely in the discussion. Some of the participants were reluctant to label relationships among ideas in their maps, and the first effort of these participants tended to present very less information regarding connection between concepts or ideas.

These differences in the cognitive maps may be explained by the amount of effort that participants put into their maps. As Corno and Mandinach's theory of self regulated learning suggests, learners adapt the level of effort and the ways in which they acquire (attending, rehearsing, monitoring, strategic planning) and transform (selecting, connecting, tactical planning) information to the situation [Corno & Mandinach 1983].

In the most involved mode of learning, comprehensive engagement, learners use all the learning processes and skills optimally. When learners are focused on a task, they emphasize transformation processes of selecting important information, connecting new information to already known, and making tactical plans to achieve the task. When learners are presented with situations that either encourage or force them to manage their resources, they expend effort in finding ways to avoid all or part of the effort (such as working with others to share work). When learners are in a passive position, such as a lecture situation, they receive information and avoid transforming processes. Therefore in this study participants modified their maps after the discussion session because sharing ideas made them identify the missing links and fill the gaps between ideas and concepts, reduce verbatim, etc. The modified maps were more complete. Cognitive mapping as a information manipulation strategy enhanced students' abilities to understand complex materials.

The asynchronous environment affords learners the time for thoughtful analysis, reflection, and composition as discussion of an issue evolves. Furthermore, the discussions are products that the teacher can review and grade and on which he/she can give feedback.

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4. Conclusions

The individual cognitive maps produced after self-study could be a useful tool for discussion in a distributed learning situation. The learners could understand the text more thoroughly after the discussion session and modified their maps accordingly. Therefore, in this way cognitive mapping could be an effective organizing tactic in metacognitive and reflective thinking learning strategies.

Discussion in a distributed learning environment offers the potential for realizing the intellectual goals in higher education; to move beyond transmitting information and testing for facts and procedures. Issue-based or focused discussions provide opportunities for modeling of higher-order thinking skills and collaborating members provided cognitive scaffolding. As compared to synchronous discussion asynchronous discussion affords the opportunity for learners to engage in critical thinking. Database of asynchronous discussion affords the teacher to assess learners based on the quality of their thinking.

5. References

[Austin 1993] Austin, A. (1993). What matters in college. San Francisco, CA: Jossey-Bass Publishers.

[Clarke 1991] Clarke, J. H. (1991). Using visual organizers to focus on thinking. Journal of Reading, 34(7), 526-534.

[Corno & Mandinach 1983] Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. Educational Psychologist, 18(2), 88-108.

[Cotton 1995] Cotton, J. (1995). The Theory of Learning, London, Kogan Page.

[Duffy, Dueber & Hawley 1998] Duffy, T. M., Dueber, W., & Hawley, C. L. (1998) Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems. In C. J. Bonk & K. King (eds.) Electronic collaborators: Researching the discourse of learner-centered technologies.

[Johnson & Johnson 1993] Johnson, D. & Johnson, R. (1993). What we know about cooperative learning at the college level. Cooperative Learning, 13(3), 17-23.

[Jonassen 1996] Jonassen, D. H., (1996). Computers in the Classroom: Mindtools for Critical Thinking, Englewood Cliffs, NJ: Printice-Hall Inc.

[Jonassen, Bessner & Yacci 1993] Jonassen, D.H., Bessner, K., & Yacci, M. (1993). Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge. Hillsdale NJ: Erlbaum.

[Madhumita & Akahori 1998] Madhumita & Akahori, K. (1998) Pedagogical principles in the design and development of a Internet based system of problem based learning. Proceedings of ICCE'98, vol.2, 115-119.

[Novak & Gowin 1984] Novak, J. D. & Gowin, D. B. (1984). Learning how to learn. Cambridge: Camgridge University Press.

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Content Management Systems for Editors - In Search of Quality

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Abstract: In September and October 1998, GMD performed an evaluation of Content Management Systems (CMS) on behalf of one of its co-operation partners, a big German newspaper. These tools should enable interactive and collaborative production of a newspaper on the Web. This paper basically describes the test methodology and the framework for the tests together with the experiences made in running the evaluation. As the number of Content Management Systems is increasing with each new trade fair, the results for the systems under test can only be a snapshot. Therefore, the main purpose of the paper is to introduce the methodology and to give future evaluators valuable hints for their assessment of Content Management Systems.

Chapter 1: Introduction

Producing a newspaper today, on paper or on the Web, is done by work groups of people who are geographically dispersed, who may not share common working hours, and who in most of the cases have a completely different working style [European Commission 1998]. While this kind of freedom is very nice for the individual newspaper editor, certain rules, arrangements and deadlines have to be respected from the newspaper publisher's point of view. In order to keep the obstacles to work in a distributed editorial staff as small as possible, to guarantee a consistent state of the next newspaper edition, and to meet the deadlines imposed, the introduction of an editorship system is very usual and welcomed today.

For online journals and newspapers on the Web it is even more complicated to guarantee consistency as the production speed is much higher, as the number of Web pages to be maintained is growing fast, as topicality is a must to attract new audiences, and as it is technically possible to produce new newspaper editions hourly. A scenario where different editors work together on a common workplace called 'Unix file system' is not acceptable in most of the cases. A special class of Web site management tools are needed here, online editorship systems which we call 'Content Management Systems (CMS)' in this context.

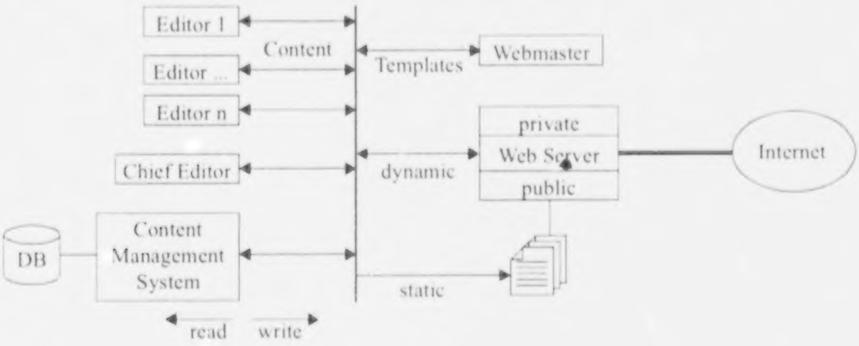

Figure 1: Content Management System Architecture

Content Management Systems [Fig. 1] provide facilities for different members of the editorial staff to review and discuss drafts for Web pages and finally to publish them on the Web. The implementation of different roles is possible, be it author, editor, chief editor, contributor, reviser, Webmaster or publisher. The insertion and removal of Web pages is done semi-automatically while keeping link consistence, the changing of style sheets is simplified. As several products, commercial and with academic origin, are on the market to fulfil these needs [Reibold 1998], a situation analysis, an investigation and an evaluation has to take place before introducing a new system in the publishing work flow and process. In September and October 1998, GMD performed such an evaluation of Content Management Systems (CMS) on behalf of one of its co-operation partners, a big German newspaper [Bissel et al 1998]. The need for a CMS is not only for producing a newspaper, other non profit organizations like the German Government are also planning to produce their Web site with a database driven CMS.

Three steps have to be taken for the quality assessment of Content Management Systems (CMS). First, the quality characteristics, - objective and subjective -, have to be identified together with the customer. Then, the possible candidates for a CMS have to be figured out, again in perfect agreement with the customer. At last, the systems' quality has to be measured in a trial to identify the best fitting candidate [Haake 1997].

This paper is structured as follows: Chapter 2 presents the quality criteria identified in detail. Chapter 3 describes our method to find the candidates for our trial and our quality assessment procedure while chapter 4 introduces the systems under test. Our general findings in performing the trial and the final end results can be found in chapter 5. Chapter 6 concludes the paper with a self-assessment of our work and some hints for the future.

Chapter 2: Quality of Content Management Systems

With a Content Management System (CMS), content and layout components can be stored, retrieved, edited, updated, controlled, and output by a variety of different workers, such as authors, contributors, editors and Webmasters. Each user group has demanding expectations of a CMS with different priorities. Roughly spoken, the Webmaster sets up priorities in the data repository and in the provision of templates whereas the real users of a CMS need an intuitive user interface, beneficial editorial tools and well designed work flow schemes.

If the system will be accepted by the users the update process of an online newspaper will be more and more efficient and economic concerning time and costs. So the definition of the right goals for a CMS as outlined in the next chapter is the most important work during an evaluation of a CMS for an online newspaper or another company or organization. During our evaluation the following quality characteristic categories worked out to be decisive.

2.1 Functionality

Editorial tools: The users are comfortable with text editors, word processors and here and then Web editors (HTML editors). The ideal tool would be the direct change of the components within the Web page via a Web browser ('WYSIWYG'). The import of already existing texts and Web pages must be possible. The editors need to have a look at the structure of a Web page, but can take the content as focus: The tool will provide the correct output.

Data repository: A central part of a CMS is document management. It is important that the data repository consists of a database to facilitate the whole management of the content and the layout components. The underlying database must guarantee consistence and allow concurrent access as well as a backup mechanism. Commercial databases will be the best candidates and provide standard interfaces.

Work flow scheme: One of the main reasons to introduce a CMS is the participation of multiple authors, contributors or editors in producing online articles. Accordingly a well-designed work flow scheme is needed which keeps track of an articles' status, if it is still in work ('draft'), if it has been returned to the author or another reviser for re-work or if it has been accepted in its final form.

User interface: Authors, contributors, and editors are often pressed for time in producing an online newspaper. They will only use a CMS if it gains time. They should not change between a bunch of programs but benefit from one single user environment.

2.2 Management

The stability and reliability of a CMS implementation tips the scales. The amount of downtime and error messages and the average update time of storing and retrieving an article are stability features. They are decisive for the acceptance among the editorial staff.

2.3 System Requirements

Naturally, the CMS has to meet special hardware and software requirements and standards, according to the existing environment of the special customer. There are preferences for some operating systems, Web server or database products, and output utilities are needed for the exchange of data with other systems.

2.4 Costs

Even if the amount of costs for a CMS should not be the decisive aspect in such an evaluation, it has to be taken into account. It is important to distinguish between the costs for the software, for training, for the switch from the old software environment to a CMS and the ongoing costs i.e. maintenance costs.

2.5 References

It is very important that the winner of the evaluation has successful implementations within similar companies or organizations which can be interviewed or even visited.

These categories were the base for the single test sequences (as described in the next chapter) the different user groups had to walk through.

Chapter 3: A Test Methodology

3.1 How to find Candidates for a Content Management System

The business and the requirements of the special customer who wants to implement a CMS are in the focus of the test methodology. So what we did at the very beginning was to make an inquiry among the biggest German online newspapers with a daily update cycle to find out if they benefit from a CMS. The sobering result was that only a minority of the online newspapers use commercial Content Management Systems. Some of them have homebred solutions only fitting their specific criteria, but the biggest part of them use Web editors and their own scripts tailor-made for their daily work.

With a market survey we complemented this inquiry to a bunch of CMS out of which we identified together with our co-operation partner the first five as candidates for our evaluation study. We do not claim the list to be complete.

- InfoOffice by InfoOffice (http://www.infooffice.de)
- NPS by infopark (http://www.infopark.com)
- StoryServer by Vignette (http://www.vignette.com)
- Hermes Online by Unisys
- WebIntegrity by MKS (http://www.mks.de)
- Caesar by Comlab (http://www.comlab.co.at)
- Edition by Visual Bridge (http://www.visualbridge.com)
- GroupWise WebPublisher by Novell (http://www.novell.de)
- Imperia by Cyberlab (http://www.imperia.de)

3.2 How to evaluate a Content Management System

When trying to find the most appropriate system, we were confronted with a multi-criterion decision problem. It is obvious that there is no single overall criterion that reflects the quality of such a complex system. The situation gets even more complicated when the different user demands towards a Content Management System are taken into account.

For this kind of decision problem, the use of a benefit value analysis can lead to the right system for one's needs [Zangemeister 1993]. The starting point for a benefit value analysis is to set up a hierarchical goal system. Each alternative's goal productions are then determined. All goal criteria have to be weighted, so the partial benefit values can be accumulated afterwards in order to build a single benefit value for each alternative.

The resulting preference score is demonstrable and can be subsequently screened. On the other hand, the subjective goal weights can be manipulated to get the desired preference score. To review the influence of varying goal weights on the decision made, a sensibility analysis should be performed. An important gain of a benefit value analysis is the clarification of the needs by setting up a goal system.

A weak point may lie in the way the accumulation of the partial benefit values is done, because it assumes that the partial benefit values can be measured cardinally and the criteria are benefit independent of each other. Done accordingly and with these restrictions in mind, the benefit value analysis is a valuable tool for solving multi-criteria decision problems.

3.3 A Finite Test Plan

Due to time restrictions, - we had given only 4 weeks to perform the test -, a complete benefit value analysis could not be performed. However, our evaluation was partially based on its concepts to ensure transparency.

In co-operation with our partners, two lists of criteria were drawn up, one reflecting a system administrator's point of view, another the editor's. A single criterion was weighted as being 'crucial', 'nice to have', or being 'less important'. Each system had to be examined with regards to these criteria. This was done in descending order of preference by

- installing an evaluation version of the system and creating a demonstration project on which the work of an editorial office could be simulated.
- getting an account on a demo system supplied by the vendor.
- reviewing the available product documentation and investigating reference customers.

Though the most time consuming method, getting and installing an evaluation version of the software offers the most valuable experiences on ease of installation, system management needs, hardware requirements, performance, and stability. We jumped by ourselves into the different roles within a newspaper editorship.

Chapter 4: The Systems under Test

InfoOffice, StoryServer and NPS were the only systems out of the enumerated systems in chapter 3 that fulfilled the requirements of a Content Management System. We did not test the other systems according to the arrangements with our co-operation partner.

4.1 InfoOffice by InfoOffice

InfoOffice is designed for the management of middle-sized Web sites. It consists of different components to separate the content and the layout of a Web page. The template editor is the so-to-say layout tool that allows Webmasters to define the general structure of a Web page. The templates may contain different types of objects such as links, texts, graphics, database requests, or containers (which specify a special area of the Web page and again may contain another bunch of structural elements). Based on these templates the authors, contributors, and editors are able to fill the substitutes with the according content.

The InfoOffice Client gives the editors a limited view on the templates corresponding to their responsibilities and access rights. Access to a limited subset of the functions is also possible through Java Applets. The combination of the templates and their embedded objects with the Web pages is stored in a flat file database.

The construction of the final Web page is the task of the InfoOffice Generator which combines the layout and content components to a static Web page. This Web page may be exported via ftp to any Web server. The InfoOffice tools themselves can only be implemented in a Windows environment, but the Web Server could be any of the known Unix Web servers.

If the intention is to build up the Web pages dynamically i.e. via a database, the Web server and the database have to run in a Microsoft environment. The InfoOffice Manager is the central tool for user and access rights management.

4.2 NPS by infopark online service

NPS (network productivity system) is a Unix based Content Management System for medium-size Web sites. The system will export static Web pages which can be transferred to any Web server. The contents in form of HTML pages or generic documents are stored in the file system. All object attributes are stored in a relational SQL database. Link management, time-based publication and archiving of contents, indexing using predefined keywords, allocation of access rights, logging, job control system, definitions of work flow for the coordination of the online publishing, and user management are provided.

The contents are organized hierarchically in publications. Layout of contents can be based on templates or freely defined. Not only plain text or HTML documents but also other text or binary formats can be integrated (mif, rtf, gif, jpeg, etc.) or may be converted via an import interface.

Development and user management can be done via HTML forms. Besides this a more powerful TCL-interface is provided to automate tasks and by which extensibility is ensured.

Users only need a forms enabled Web browser to access the system. Different system views are provided and can be customized. Several content attributes can be set, others are set by the system automatically.

4.3 StoryServer by Vignette

In contrast to the other systems in the evaluation, StoryServer is a dynamic solution. The content and layout templates are stored in a RDBMS, Web pages are dynamically generated on user request. To minimize the impact on system performance due to dynamic page generation, the caching of pages and frequently used page components is provided.

The layout of the Web pages is controlled via templates and completely separated from site content. In addition to content management, StoryServer provides application server functionality with database access and tools for Lifecycle Personalization. XML and the ICE (Information and Content Exchange) protocol are fully supported.

The system architecture consists of a content management server based on a database (RDBMS) to store content, templates and system configuration. Access to the content is achieved by application servers, one for development purposes and another to serve the live Web site.

The StoryServer tools are a suite of Java applications that allow content and project management, site development, user administration and overall system configuration and provide facilities related to personalization and log analysis.

Content entry and modification are done through HTML forms, contributors only need a Web browser. It is possible to define a work flow for the publishing process, so that chief editors are informed on new submissions and must review them prior to making them available on the live server. Articles can have both a launch and expiration date assigned that automatically controls the availability to site visitors.

Chapter 5: General Findings

5.1 User Interface most important

It is not possible to rate the different systems without having implemented them and tested them in practice with real editors. There are systems that impressed through a great fulfillment in the range of functionality but that were extremely complicated in the day-to-day operation. A simple Web user interface with intuitive functions is most important. Best case it must be possible to change a link or a text component without any special training.

5.2 No short-term Decision

The introduction of a Content Management System has effects on the management of data, on the work flow of the Web page production from scratch, and on the costs of an update process. Consequently the decision for a special CMS should be a long-term decision. A competitive and innovative Web Site with brand new contents should no longer be managed statically but dynamically, with all its layout and content components stored in a database and retrieved out of a database vice versa. The content should be XML tagged, in doing so the CMS should be able to interpret XML tags and retrieve special metadata information out of them.

The importance of such a long-term decision should be mirrored in the budget being available for the software and hardware requirements as well as for the training of the authors, contributors and editors. The costs for the upgrade and migration of data and the change of the work flow scheme of the production cycle must not be underestimated as well.

5.3 Benefits are obvious

„Some say that a CMS is a money pit where the spending continues for ever. That is true - but it is a positive thing, ...“ [Kartchner 1998]. The benefits of a CMS predominate the costs of a CMS. One large benefit is the same software environment for all workers, if they are part-time or full-time, newcomers or experienced ones. Additionally the amount of manual work will decrease more and more and consequently the costs of an update process too. Another great advantage is the availability of the content in a usable electronic form over years. With a return on investment model [Kartchner 1998] it has been shown that the reducing of costs with a CMS only begins in the second edition that means in the second year of a CMS in comparison with other publication methods.

5.4 Best Fit

From our evaluation candidates, we chose StoryServer by Vignette as the best forward-looking solution, in spite of its exaggerated costs. StoryServer does not fulfil all of the quality criteria which cannot be expected from any system but most of them in comparison with InfoOffice and NPS. StoryServer is best suiting the management of large-sized Web sites where the biggest advantage is the storage and retrieval of all components within a database in a UNIX environment. The software and its documentation seem to be professional as well as its manufacturers, the user interface is a simple Web interface.

5.5 No general solution

Among web publishers, the need for a scalable, dynamic CMS is growing, the German Government for example, is also planning on basing their Web site on a database driven solution. StoryServer is not the best fit for all types of Web publishing due to its price tag and often unneeded functionality, especially for smaller or nonprofit Web sites.

DynaBase by Inso (http://www.ebt.com/dynabase) is a CMS we discovered after our evaluation. Unfortunately, although the product features look promising, we couldn't get a test installation or anything else from Inso, so we decided not to further consider DynaBase.

Our continued search has led to finding CoreMedia Content Publisher (COREM) by Higher-Order (http://www.higher-order.de/Produkte/GOODNews/index.html) with a better cost-benefit ratio. This modular system is built on open standards like CORBA and Java, based on a standard RDBMS and it is able to produce static as well as dynamic pages. Although COREM is a relatively new product that is missing some advanced features, these will be added during the next months by Higher-Order or can be developed by ourselves if needed to a nearly '100% solution'. Besides that, we will continue watching the market.

Chapter 6: Conclusion

The assessment of objective quality characteristics for Content Management Systems like performance or management (see chap. 2.2) relies on numbers to be measured. Once defined, the assessment can be automated by robots or intelligent agents and it can be repeated whenever the customer wants it.

Most of the quality characteristics however are subject to individual assessment and by that subjective like 'ease to use'. You really need a real-life user group here and you really have to go through the trails with them on and on. Depending on the people in the user group, you will get different assessment results. With respect to the time constraints given, - the test should be performed within 4 weeks -, we had no chance to work with a user group in our trial at all.

The understanding of Content Management Systems and their benefit value relationship at our contractor's side was only sharpened during the trial. The amount of resources needed to perform a successful test was underestimated. Particularly the lack of a goal system finally led to unpredictable results.

However, with our results we provide input for future evaluations and we started a discussion in the big German newspaper. The decision for the right Content Management System together with the introduction of a database management system will be made in 1999, months after our trial.

Chapter 7: References

[European Commission 1998] European Commission (1998). *Web-based tools for document management.* Luxembourg: Office for Official Publications of the European Communities, ISBN 92-828-4140-5

[Reibold 1998] Reibold, Holger (1998). Teamgeist für Websites. *Internet Professionell*, August 1998

[Bissel et al 1998] Bissel, Torsten; Bogen, Manfred; Borowksi, Marion; Karajannis, Andreas; Loeffler, Jobst (1998). *Evaluation von Online-Redaktionssystemen, Version 1.2.* Sankt Augustin: GMD

[Haake 1997] Haake, J.M. (1997). *Autorensysteme für die kooperative Erstellung von Hyperdokumenten.* Sankt Augustin: GMD-Bericht Nr. 279, ISBN 3-486-24265-2

[InfoOffice 1998] InfoOffice GmbH (1998). *InfoOffice-Produktinformationen, Stand 03/98.*

[infopark 1998] infopark online services (1998). *Web-Publishing for Intranet and Online Services through Content-Management.* http://www.infopark.com/com/nps/handbooks.html

[Zangemeister 1993] Zangemeister, Christof (1993). *Nutzwertanalyse in der Systemtechnik*, 5. Auflage. Hamburg: Zangemeister & Partner

[Kartchner 1998] Kartchner, Chris (1998). *Content Management Systems: Getting from Concept to Reality.* http://www.press.umich.edu/jep/03-04/kartchner.html

Scriba — A Tool for Developing Java Based Web Applications

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Abstract: This paper presents Scriba — a tool that facilities the development of Java based Web applications. The tool allows the creation of script languages that can be embedded in HTML pages in order to process data dynamically. As well as the advantages of the use of Java technology, the structure in the tool's software components allows its users to redefine its functions, expanding or recreating its basic language. The AulaNet environment is an example of application developed with Scriba.

Introduction

The evolution of Java technology has made it possible for new approaches for the development of Web applications to appear. These applications possess diverse parts that may be organized in the form of software components, making the most of the potential offered by object oriented languages like Java. The software can be seen as a group of interconnected components that cooperate in order to promote the operation of the whole environment.

This paper presents Scriba, a tool that interprets commands for the fast development of Java based Web environments. Scriba makes the construction of Java based Web applications easier and quicker. Through specific markings in its language, Scriba enables data to be put on the pages in loading time. As well as possessing dynamic creation of pages with HTML templates, Scriba also makes the use of user defined script languages viable through expanding its language or substituting its command interpreter.

Scriba is being used in the development of a new version of AulaNet [Lucena et. al. 1999] an environment for creating and attending courses on the Web. The following sections give details of Scriba's own language and the way it operates.

Servlets and JDBC

The latest versions of Java incorporate two new language mechanisms used in the development of network and database applications known as servlets and JDBC. The new extension package for the Java Development Kit

1.1 (JDK 1.1) intended to be a Java substitute for CGI programs (Common Gateway Interface) is known as a servlet [Siyan and Weaver 1997]. With servlets, users can add new functions to HTTP servers.

HTTP servers that possess a servlet API provide an environment with all the resources that the servlets need to operate, and a model of security that maintains the integrity of the system. Servlets can contain any Java function or package that does not have graphic interface. They can read or write in files, process calculations, communicate with databases and create HTML files, functioning like a traditional CGI program, with the advantages of the Java language in terms of structuring in components and performance.

The latest versions of Java also incorporate JDBC [Hamilton, Cattell and Fisher 1997]. JDBC is an API for the execution of SQL statements on any relational database. The API of the JDBC allows users to write database applications using a purely Java interface. The JDBC carries out the following main operations: it establishes a connection with a database, sends SQL statements and processes the result. This solution is the one adopted by Scriba to communicate with users' databases.

Scriba

Scriba is a tool for creating dynamic HTML pages and defining Java classes to implement the processing of Web applications. Scriba offers a basic language that allows one to consult ODBC databases, exchange values stored and invoke user defined classes for the realization of functions specific to the application's domain.

Users who wish to implement Web applications using servlets and Java find the necessary elements in Scriba for the implementation of the whole application using HTML pages and Java classes. HTML pages can have the Scriba code embedded in them that carries out, among other things, data searches in any ODBC database. The Java user defined classes bring together the specific functions of the application in development. Scriba deals with all the control operations and creation of objects for the functioning of the servlets, communication with ODBC databases and operations referring to interpretation and execution of the commands of its language.

One of the main characteristics of Scriba is the possibility of configuring its functions through the user redefining its components. The structuring of Scriba in software components interrelated with well defined interfaces allows its users to rewrite most of its components. They can adapt Scriba to interpret any other language. There are two types of configuration of the Scriba functions: users can extend the basic language supplied through creating new commands in the interpreter or they can define a completely new interpreter for Scriba.

Scriba is made up of three basic components: a token divider, a command interpreter and a HTTP request receiver. Figure 1 shows the Scriba architecture and the classes that compose each of its components.

Scriba components and classes.

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The token divider is made up of two classes: *Parser* and *CodeParser*. This component is responsible for reading HTML templates and for checking the existence of the boundaries of its language. When a language token is found within the boundaries $* and *$ the divider passes this token to the interpreter so that the actions referring to the language command contained in the token may be taken.

The command interpreter is composed of the following classes: *InterpreterInterface*, *InterpreterException*, *Interpreter*, and *UserClassInterface*. So that the users write specific interpreters for their languages, the *InterpreterInterface* class supplies a pattern that a new class should follow in order to be defined as an interpreter in Scriba. The Interpreter class obeys the *InterpreterInterface* specifications through inheritance and implements the actions corresponding to each of the language commands. The *InterpreterException* class deals with all the errors created in the interpreter, standardizing the messages and explanations about the problems found in the interpretation of the commands. The last class of this component, *UserClassInterface*, defines the format that all the user defined classes for processing form values should present.

The HTTP request receiver receives the parameters passed by the HTTP server when a page is requested using the GET and POST methods. This component carries out all the necessary operations to implement the Java servlets and trigger the token divider to search the HTML template indicated looking for language tokens. This component is made up of the following classes: *ScribaGet* that deals with GET type of requests, and *ScribaPost* that deals with POST type of requests.

Figure 2 presents the execution flow provoked by the *ScribaGet* and *ScribaPost* classes for each request made to Scriba.

CodeParser
ScribaGet
ScribaPost
HTTP Server
Web Browser

: *ScribaGet* and *ScribaPost* execution model.

After being created by the *ScribaGet* and *ScribaPost* classes, objects of the *CodeParser* class inspect the HTML template supplied and pass the tokens found to an object of the Interpreter class that will take the necessary action according to the language commands. The basic language commands defined to implement AulaNet will be presented in the next section.

Operational Details

In order to implement Web environments with dynamic pages, Scriba has a basic language conceived from the necessities found in the development of AulaNet. The Scriba language has commands that search for values in ODBC databases and create user defined classes. There is also a syntax so that the user can expand the language without having to redefine the interpreter completely.

The language embedded in the HTML files obeys the following general rules:

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1. So that the code divider recognizes the existence of the commands embedded, it is necessary for them to be delimited by a marker at the beginning of commands ( ) and one at the end of commands ( ).
2. Scriba recognizes commands separated by   inside a HTML template. If it is necessary to define more than one command in the same place in a file, the user can use this construction: <command1> <command2> ... <commandN> .
3. The command lines may be situated in different places in the file, however the argument and the command name can not be divided among various lines of text.

In order to construct Web applications Scriba has 8 commands as follows: *database.open*, *database.close*, *database.select*, *database.select.set*, *database.select.set.pattern*, *class.new*, *form.parameter*, *language.expand*.

The *database.open* command is responsible for creating a reference to an ODBC database. Its argument is made up of the name of the database registered in the ODBC (DSN). This command does not return values, it just prepares the database to receive SQL requests.

The *database.close* command closes a database previously opened by *database.open*. This command does not have arguments and does not return any value. Scriba uses a *DataManager* denominated class to provide the communication services with the database. This class brings together the calls to JDBC API that implement the JDBC-ODBC bridge.

The *database.select* command allows the execution of a SQL SELECT statement about the database previously opened by *database.open*. Its argument is the SELECT statement and its return value is composed of one unique field returned by this statement. If the return of the SELECT statement implied more than one field or line, the *database.select* command would only return the first field of the first line, ignoring the rest of the values returned. For example, if the command found were *database.select:=SELECT Name, Account FROM Users*, the return of the SELECT clause would possibly be made up of more than one register containing the name and number of each user's account. Even if the SELECT clause executed returned more than one register, Scriba would only inform the value of the Name of the first user register. In order to carry out clauses like the latter example, Scriba has a special syntax of the *database.select* command which is the *database.select.set* command.

The *database.select.set* command creates a table with the values returned by a SQL query statement internally in Scriba. This command does not have a return value and its argument is composed of the SELECT statement. In order to have access to the fields stored in the table the user should indicate which pattern is to be repeated changing the fields indicated by a value in the table. The syntax used to define the repetition pattern is the *database.select.set.pattern* command. Figure 4 shows how Scriba executes the *database.select.set* command.

The *database.select.set.pattern* command has as its argument any text that will be repeated for each line in the table of returned values. Within the argument of this command, the user can indicate to Scriba one of the fields to be changed dynamically by the values in the table through the *set.name_of_field* syntax. Returning to the previous example, the *database.select.set:=SELECT Name, Account FROM Users* command would be executed, creating a table with the returned values by the SELECT clause. The user could declare, for example, the command *database.select.set.pattern:=<tr><td>set.Name</td><td>set.Account</td></tr>* to create an HTML table with the returned values of the select clause.

The *class.new* command creates a class object whose name is indicated in its argument. The object is created dynamically by Scriba to carry out Java based user defined operations. With this command Scriba allow users to program sections of Java code to make specific processes with its application. The whole class created has access to the HTML form variables, allowing the implementation of programs that deal with data like the majority of languages do. For a user to create a class that can be declared in the *class.new* command he should define the class as child of the *UserClassInterface* class of the command interpreter component. When inheriting the characteristics of *UserClassInterface* through the IMPLEMENTS declaration in Java, the user will know which methods he must create and the parameters that he will receive in his class.

If a user wants to have access from his page to some variable declared on a previous form, he can use the *form.parameter* command. This command possesses as a argument the name of the variable that he wants to have access to and returns its value. With this command the user can pass values between different templates without having to retrieve these values on all the pages.

If it is necessary to expand the Scriba language, the user can use the *language.expand* command. This command allows users to create a class that implements the *InterpreterInterface* interface to interpret a proprietary language expanded in relation to the tool's original language. This class should have an action method that will receive a token and process it, identifying the command involved and carrying out the corresponding action. There is no limit to creating classes of this type.

Scriba allow users to rewrite the main parts of two of its components: the token divider and the command interpreter. In order to guarantee compatibility between the Scriba component parts and the parts created by the user, two classes are supplied: Parser and *InterpreterInterface*. The *Parser* class should be inherited by the user defined class that will substitute the *CodeParser* class. The *CodeParser* class is useful to break the HTML template tokens. If the type of template or the language markers of the user need to be changed, all that has to be done is to rewrite the *CodeParser* class according to its new definition, inheriting the characteristics of the Parser class.

Flexible points

: Scriba architecture and flexible points.

If the language to be interpreted is completely new, the user can define a new *Interpreter* class with the language commands and their respective actions. This new class should implement the *InterpreterInterface* class, inheriting its characteristics. The new interpreter should receive tokens from the *CodeParser* class and identify the statements of its language within these tokens, creating a convenient return value for each type of command interpreted. Figure 3 shows a view of the Scriba architecture, identifying its flexible points.

Scriba for AulaNet

Scriba was invented within the philosophy of the creation of Web based cooperative software environments that use databases to store their information. AulaNet is a case of the application of this technology. There are plans to modify the AulaNet architecture, using Scriba and Java, to restructure it in object oriented components that integrate to offer the services supplied by the environment.

AulaNet is an environment for creating and attending courses through the Web. Teachers in AulaNet can create courses by selecting a set of communication, cooperation and coordination mechanisms. After choosing the mechanisms for a course, teachers can input the content that will be seen by the students. The students can communicate and cooperate to construct knowledge and carry out activities in groups. As it facilitates the creation of courses through selecting mechanisms and inserting materials AulaNet is considered a high-level solution for low-end users.

AulaNet is made up of a group of HTML pages, CGILua scripts [Hester, Borges and Ierusalimschy 1998] and an MS Access database. The CGILua tool allows the creation of dynamic HTML pages and the processing of HTTP requests. CGILua possesses a library for communication with ODBC databases. AulaNet uses Microsoft

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Access to store its data. Approximately 90% of the functionality of AulaNet is implemented using these components. The other 10% is made up of freeware software and two commercial softwares, offering the main part of the communication functions supplied by the environment.

The strategy adopted to substitute CGILua with Scriba will be guided to reduce the number of files in the software. The programs that would be executed in the templates to compose the page dynamically will be transformed into one or more Scriba commands, as they only use database functions. The Scriba functions map out the majority of the actions performed to search for data and exchange parameters in the templates.

The new version of AulaNet should benefit from some improvements brought about by the use of Java technology, like the portability of the programs developed. Another improvement brought about by the use of Scriba is the access to databases. As AulaNet uses the Access database, some concurrency problems were identified when various simultaneous accesses were performed in the database. The use of the JDBC to access the database reduces the problems of concurrency, as all the access methods used are synchronized by the monitor mechanism implemented by the Java language.

There are plans to create a software documentation pattern, benefiting from the reduction of files brought about by Scriba. The number of files in the Scriba based version of AulaNet should be approximately 50% less than the number of files in the current version, based on the experience of implementing 25% of the software already made until now.

Conclusion

Scriba, a tool for creating Web based applications, aims to simplify the creation and maintenance of Java based applications. Scriba adapts well to the types of applications that store information in ODBC databases. In order to implement its capabilities Scriba possesses a component structured architecture.

To facilitate creating dynamic pages Scriba has a language that executes SQL statements and creates user classes. The Scriba language also has the capability to recognize extended commands, allowing users to broaden the capabilities of its language without having to change the Scriba components. Another interesting characteristic of Scriba is the possibility to redefine the tool's components. Users can redefine the language to be interpreted and its markers through the redefinition of the classes responsible for the identification of language tokens and command interpretation.

Some improvements can already been identified for a future version of Scriba, according to the results obtained in its use:

- extension of the basic language;
- capacity to insert code directly in the script;
- a new approach for developing TCP/IP generic servers and clients by the definition of their communication protocol.

Finally we aim to develop Scriba so that it can possess a form of graphic representation of applications that allows the creation of a tool for the semi-automatic generation of programs. This will enable users to specify the application with graphics and create pages that compose it visually, avoiding contact with the code prematurely.

References

Hamilton, G., Cattell, R., & Fisher, M. (1997). *JDBC Database Access with Java – A Tutorial and Annotated Reference.* Addison-Wesley.

Hester, A., Borges, R., & Ierusalimschy, R. (1998). Building Flexible and Extensible Web Applications with Lua. *WebNet'98-World Conference of the WWW, Internet & Intranet, 1998*, Association for the Advancement of Computing in Education, Charlottesville, VA.

Lucena, C. J. P., Fuks, H., Milidiú, R., Laufer, C., Blois, M., Choren, R., Torres, V., & Daflon, L. (1999). AulaNet: Helping Teachers to Do Their Homework. *Multimedia Computer Techniques in Engineering Education Workshop*, CMES (Computer Method in Engineering Science) Network, Graz, Austria. 16-30.

Siyan, K. S. & Weaver, J. L. (1997). *Inside Java*. New Riders Publishing.

W3Gate - The Final Case Study

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Abstract: This paper is the last paper about W3Gate, a gateway which allowed the access to the World Wide Web through electronic mail. It is about an approach to turn an academic project into a commercial one and about a marketing strategy which unfortunately failed. The purpose of the paper is to document and close the chapter W3Gate finally and to give software developers valuable hints for a successful marketing of their software.

1. Facts about W3Gate

W3Gate was a gateway between email and the World Wide Web (WWW) that enabled email users to retrieve multimedia objects in the Web. This could be done independently of the email protocol used, be it Internet or OSI mail, and asynchronously. An email sent to the address 'w3mail@gmd.de' requested WWW, FTP, WAIS, and Gopher documents. Even password-protected documents were retrieved by specifying the respective userid and password within their URLs [Berners-Lee et al. 1994]. Plain files (HTML, pictures, audio, video, ...) could be fetched through W3Gate and search requests at search engines like AltaVista, Lycos, or infoseek could be performed.

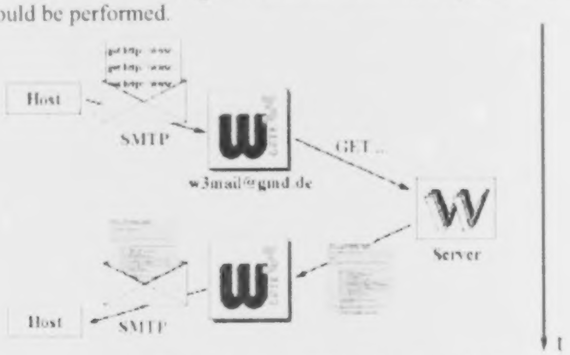
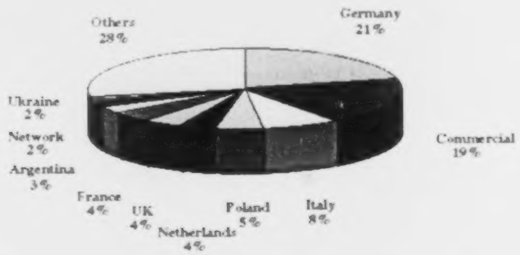


Figure 1: The W3Gate Functionality

W3Gate supported raw and formatted documents, encoding and compression, text and postscript versions, multiple documents, MIME, and partial messages. Files were accessed via *HTTP*, *FTP*, *GOPHER*, and *WAIS*. Users from more than 80 countries were using W3Gate regularly. They were from universities and schools but also from profit organizations. [Fig. 2] shows a typical user distribution among top level domains.

Figure 2: W3Gate Usage per Country



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Since W3Gate started its work in May 1995 the number of transmitted files grew to 700.000 files a day. Simultaneously the traffic increased to 20 GB per month. Some declines in the usage-statistics were caused by operational problems and misuse. Finally, people used W3Gate in spite of our announcement about its end of service until the very end.

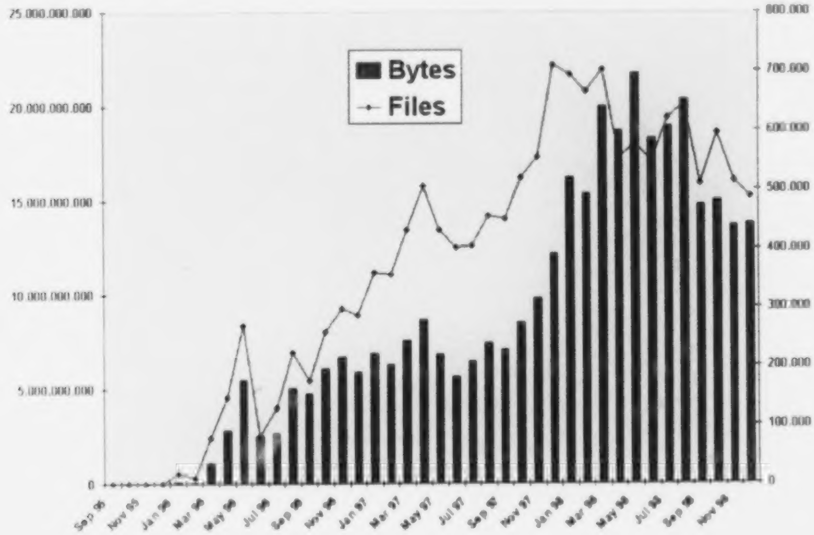

Figure 3: W3Gate Overall Traffic

Under the influence of these numbers, the statistics gathered, the service's success, and the demand of different organizations to have the software, it was finally decided to start a commercially oriented project based on W3Gate. The goal was to get additional funding for maintenance and further development.

This paper is structured as follows: [A Marketing Plan] reports our marketing strategy. [Marketing Activities] describes our attempts to make the W3Gate software distribution a success. [Marketing Results] outlines our achievements while [The End and Lessons Learned] describes the bitter end of the service and our general findings.

2. A Marketing Plan

A few questions had to be answered in defining a successful marketing plan:

1. Who buys the product and/or service and why?
2. Where are the competitors and what is their marketing strategy?
3. What is the best sales strategy in advertising and promotion?
4. What are the best dealerships and/ or distribution channels to get the product to the market?

2.1. Who and Why?

Studies of German publishers about the WWW usage had shown at that time that only in some cases (shopping, entertainment) a real interactive component was needed [Fig. 4]. The rest of the WWW usage was information or data retrieval which could be covered by asynchronous electronic mail requests perfectly.

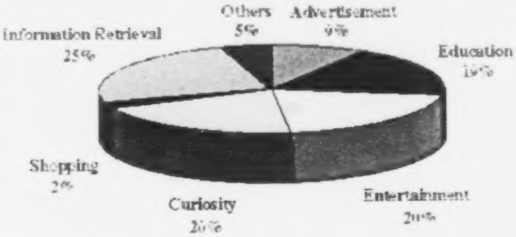

Figure 4: General WWW Usage

We therefore saw several different potential customer groups to buy our software:

- Mail(box) service providers wanting a Web gateway as additional service for their customers.
- Content providers wanting W3Gate as integral part of their WWW information offer for the convenience of their readers.
- Companies with an Intranet providing their employees with a secure Web access via a gateway/proxy.
- Firewall manufacturers wanting W3Gate as proxy server for network security purposes.

2.2. The Competitors

There were almost no other competitors in the market. Other systems like the agora system [Secret 1994] had stopped their service in the meantime due to traffic load and resources consumption. We thus had a high-quality product or service with a strategic position in the market together with satisfied clients who trust in the product or the service, and reliable, enhanced, and sophisticated usage statistics.

2.3. A Sales Strategy

At first, we saw different possibilities to sell W3Gate:

- as public domain software,
- as shareware software,
- as a real licensed software product,
- as service in different gradations: a basic, limited service free of charge, and an advanced service for authentic customers,
- as basis for a co-operation with a potential partner where GMD should only be responsible for the technical enhancement of W3Gate,
- as regular, value-added service operated and billed by GMD, or
- as a regular, value-added service on behalf of a co-operation partner or funded by sponsors.

The first two alternatives meant no obligations for us at all but could not bring additional funding for further development. For a real, paid service however we had needed a performing accounting and billing mechanism, and a secure payment method which we definitely did not want to establish. Finally, we decided to follow two commercial paths: to sell software licenses to interested parties and to establish a service on behalf of a sponsoring third party, interested in W3Gate's feature to attach commercial information to the HTML documents originally requested.

2.4. Dealers and Distributors

As we were (and are) no marketing experts and as we wanted to concentrate on further developments we did not want to do the marketing for W3Gate by ourselves. We finally found a co-operation partner with promising contacts and experience willing to support us in following the W3Gate commercialization path.

3. Marketing Activities

A license agreement for the software sale and a co-operation agreement related to a sponsored third-party-service were signed. The distribution of tasks was rather straight forward: GMD was responsible for the W3Gate technology, our co-operation partner for the sale, the marketing, and the advertisement. W3Gate was integrated into the product offer of our marketing partner at once.

3.1. Licensing

We set up a licensing scheme with different service levels and different prices depending on functionality wanted and the size of a customer's company or organization (1-15, 16-50, 50-1000, > 1000 employees). The service levels started with the software package itself plus online documentation and ended in a package with the software, printed manuals, installation support, and hotline access.

3.2. Sponsoring

Sponsoring is a quite common business model within the Internet. Most of the Web indexes and search engines are funded this way. Sponsors want something in return for their financial engagement. So we implemented the ability to attach sponsor information to the documents requested through W3Gate.

The sponsors were planned to pay for the number of banner views per month. A banner was allowed to be 400*100 pixels (12 KB) and could include 4 lines of text with 80 characters each in order to avoid overloading the W3Gate replies. Apart from a fixed set-up fee for the service (ad-server)and the banner itself, we offered 4 different packages (containers) starting with 1000 electronic mail messages transporting the banner a month and ending with 100.000 electronic mail messages containing the banner. The more banner views a sponsor was willing to buy, the cheaper the price for one single banner view should be.

3.3. Promotion

We promoted W3Gate from the very beginning and quite successfully [see Bogen et al 1996a]-[Bogen et al. 1997c]). It started with a poster during the WWW4 conference in Boston in 1995. After that we were present at all subject-related WWW/Internet conferences at that time like JENC7 in Budapest, JENC8 in Edinburgh, INET'97 in Kuala Lumpur, and finally WebNet97 in Toronto. Additionally we gave talks about W3Gate on national and international workshops and user group meetings (W3C, DECUS Munich). A few articles in computer-related German newspapers described the W3Gate functionality. Some books about electronic mail additionally also mentioned W3Gate as a good and performing example [Rudolph 1998].

While the papers and presentations mentioned were targeted to the scientific community and end users, we also tried to get in contact with real customers. We exhibited W3Gate at the Systems'97 in Munich [i.e. the 16th international trade fair for information technology and telecommunications], the OpenNet conference 1997 in Berlin, and at the CeBIT'98 in Hanover, which is the biggest trade fair for Office, Information, and Telecommunications in the world.

Our performances were accompanied and supported by the corresponding written marketing material like product sheets, price lists, posters, flyers, logos, contact sheets, and articles in the brochures of these trade fairs. It was sent in time to hundreds of addresses of potential customers especially in the computer and information technology industry. Information about W3Gate was offered to the editorial offices of journals and newspapers for publication and people were invited to visit the W3Gate stand booth. During those fairs, we actively tried to establish contacts to new customers by visiting their booths. Additionally, we offered special discounts for the duration of the trade fairs.

Our addresses of people/organizations interested in obtaining the W3Gate software collected over the years were used by our marketing partner for contacts and to ship latest information about the new order possibilities and our pricing scheme. News about W3Gate were published in GMD's monthly newsletter to about 2.000 service customers.

A WWW server 'www.w3gate.de' was maintained providing information about the functionality, the usage, and the licensing of W3Gate. W3Gate appeared on our companies homepage as central GMD service. We had separate e-mail contacts for sales and support and a frequently-asked-question file (FAQ) for the online visitors.

4. Marketing Results

We started a lot of activities, but our marketing plan did not work out.

4.1. Software Sale

Only a few numbers of contacts were made during the trade fairs. The contacts made to firewall suppliers were not very promising. Their initial interest disappeared very soon after the trade fairs. It turned out that our first pricing scheme was too high. As a result, the plan to attend Systems'98 in Munich and the idea to sell W3Gate to end users was completely dropped.

4.2. Sponsoring

We talked with the German Research Network Association (DFN), the IP Service Provider for the scientific community in Germany, about offering a W3Gate service together with other central value-added services. Unfortunately, it turned out that IP Service Providers (ISPs) prefer to invest into the backbone itself rather than funding a bypass for connectivity problems.

4.3. Ad Services

We made some tests with banners added to the W3Gate messages on behalf of a company selling banner views. Based on the usage statistics provided by us, W3Gate seemed to be a promising option for them. The results of the test were really disappointing. 100.000 mail messages were sent in the test period and they resulted in 100 clicks to the banner advertisement appended. This was completely unusable for advertisement. A percentage of 1-3% is normal. W3Gate users seem to concentrate on the information requested and filter the advertisement completely out.

5. The End and Lessons Learned

Finally, the author and 2 W3Gate developers left us for different reasons. Together with our failed marketing attempts this made us stop our service first and our commercialization activities next. We announced the end of the W3Gate service quite in time. Each document requested through W3Gate had this information as additional body part/ attachment with it from August, 20th 1998 on. Additionally, we propagated this fact in our national monthly newsletter and we sent it to the people in the customer database. We still offered the possibility to buy the software for one's own purposes, but the reaction was minimal.

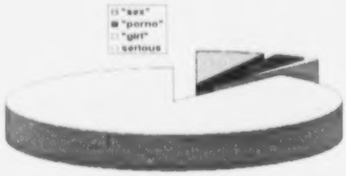

Figure 5: W3Gate usage per content

What went wrong? The high usage until the last day shows that lack of functionality was not our problem. By analyzing the statistic numbers we found out that W3Gate had been used for 'real' work and not for retrieving anonymously files with strange contents ('sex', 'girls', 'porno') [Fig. 5]. In principal, there should have been serious customers and chances to sell the software or to find a sponsoring co-operation partner.

5.1. No Plug-in Available

It would have been very convenient for end users to have W3Gate as a plug-in for a WWW browser. Each time they wanted to have an HTML page referred by an URL to be sent to them without waiting (asynchronously), they could have just pressed a button starting a job for W3Gate to fetch the referred document and send it to them through e-mail. Unfortunately we had no contact to the WWW browser industry (Netscape, Microsoft etc.) to discuss this possibility with them and somehow we additionally felt that these companies could develop a software like W3Gate much faster and better than us if they only wanted to.

5.2. A High-quality Service Free of Charge

There was really no need to buy the W3Gate software as long as there was a high-quality W3Gate service with almost no restrictions. We had an academic interest in the software and therefore wanted to have a testbed for further developments and new ideas. However, finally the service operation was counterproductive to the marketing and sales activities.

5.3. An Inappropriate License Model

An appropriate license model is the most important factor in a successful marketing strategy, sometimes even more important that the quality of the software itself. We had the wrong one. The right way to do successful marketing for a software package is:

- Maintain a public service for interested users free of charge (what we did).
- Give the software (binary code) away to the academic community free of charge to do research and development with it (download) and make it known by that and people used to it.
- Give test licenses to commercial users/customers free of charge who do not want to use the central service for whatever reasons (security!) and who want to install it in their premises (download). This should be done with restricted functionality only, where the restrictions may apply to the number of users at a time or to the time period for the trial. After the trial, licenses should be required.
- Make reasonable, small prices for the commercial users/customers wanting to buy (once) and keep (renewal) the software after their trials.

We underestimated the multiplication function of giving the software for free to the academic community for research and education purposes. So, the software was known only to a limited group of actual users of the central service. A customer reference list is very convincing for new customers. Nobody wants to be the beta tester. As we kept the software, we were not capable to built it up.

5.4. Starting Late

The major interest in W3Gate started in summer 1996 when the software was new and when a similar server had just collapsed. We waited too long and found our marketing partner too late, only in autumn of 97, to follow the contacts made. The marketing campaign started only in October 1997. Right Time, Wrong Place

As mentioned, we were present at several trade fairs to sell our W3Gate software package. At the CeBIT trade fair, the product presentation was embedded into the booth of our company which is a big research lab and by that not a place where people expect to buy software. Therefore another hall for sellers and resellers would have been the better place for us.

5.5. A Marketing Partner

Our marketing partner was not as powerful and active as expected. W3Gate was just one of their products even with smaller earnings for them. Additionally, they had plans at that time to start a daughter company in the US which also took a big part of their concentration. Being a small, rather new company they were not experienced enough for the W3Gate exercise and they did not have the relevant contacts needed and expected to commercialize the W3Gate software.

5.6. National Publications Missing

With our publications about W3Gate we addressed an international scientific audience. We did not try to reach end users who normally read German newspapers, German semi-scientific journals, or manager magazines. An article about W3Gate here would have helped a lot.

5.7. Plain Old Mail

Electronic Mail is no hot topic any longer. World Wide Web, video communication, business TV, or digital audio broadcast are of interest today especially for marketing people. Compared to the World Wide Web, the number of bytes transported through e-mail is insignificantly small. Electronic mail services are taken for granted, they are as normal as the telephone today.

6. Conclusion

Together with our co-operation partners we put a lot of efforts and money into the marketing of W3Gate. Finally we were not experienced enough to succeed. We did not sell a single license of W3Gate and we did not earn a dime through advertisement, fees, or sponsoring. Maybe a spin-off company for W3Gate early enough could have been a better solution, but this is another risk to go.

7. References

[Berners-Lee et al. 1994] T. Berners-Lee, L. Masinter, M. McCahill, "Uniform Resource Locators", RFC 1738, 1994
[Bogen et al. 1995] Manfred Bogen, Guido Hansen, Michael Lenz: W3Gate - An E-mail Access to WWW, in: Poster Proceedings of the 4th International World Wide Web Conference in Boston, O'Reilly & Associates, pp. 70-71, 1995
[Bogen et al. 1996a] Manfred Bogen, Guido Hansen, Michael Lenz: W3Gate - A Web Access for Outsiders, 7th Joint European Networking Conference JENC7, Budapest, May 13-16 1996, Proceedings of JENC7, pp. 111-1 - 111-10
[Bogen et al. 1996b] Manfred Bogen, Guido Hansen, Michael Lenz: W3Gate - A Web Access for Outsiders, in: Computer Networks and ISDN Systems: Selected Papers from the 7th Joint European Networking Conference, Volume 28, Number 14, pp. 1979-1990, Elsevier, Amsterdam
[Bogen et al. 1997a] Manfred Bogen, Guido Hansen, Michael Lenz: W3Gate - The Service, 8th Joint European Networking Conference JENC8, Edinburgh, May 12-15 1997, in: Proceedings of JENC8, pp. 723-1 - 723-9
[Bogen et al. 1997b] Manfred Bogen, Guido Hansen, Michael Lenz: W3Gate - Use and Abuse, INET 97, The seventh annual conference of the Internet Society, Kuala Lumpur, June 24-27 1997 , Proceedings of INET'97, CD-ROM
[Bogen et al. 1997c] Manfred Bogen, Guido Hansen, Michael Lenz: How to Make Money with Web Access, Proceedings of WebNet 97 - World Conference of the WWW, Internet and , pp. 72-77, ISBN 1-880094-27-4
[Bogen et al. 1998] Manfred Bogen, Stephan Vavra: W3Gate: Die Brücke zwischen E-Mail und World Wide Web, Der GMD-Spiegel, März 1998, 1-1998, pp. 16-17.
[Rudolph 1998] Mark Torben Rudolph: E-Mail kannich, Data Becker Verlag, ISBN 3-8158-1299-2
[Secret 1994] A. Secret: Agora, for those who cannot be in the Arena, http://www.w3.org/hypertext/WWW/MailRobot/send.html, 1994

The Transition from Contemporary to Virtual User Interfaces for Web-Based Services

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Abstract: Computer and Internet based services are increasingly provided to users in our days. The users are also increasing exponentially and it is obvious that they are not experienced in the use of computers. This paper examines the problem of user friendly web based service interfaces and proposes a new kind of interface. This interface is called a Virtual Interface and is thoroughly presented. The Virtual Interface is compared to contemporary User Interfaces and the results of this comparison are also presented.

Introduction

In our days, it has become essential to be able to work with computers and communicate through them. In order to improve the efficiency of Human-Computer Interaction, computer and software manufacturers have developed friendly user interfaces. A User Interface (UI) in general is the medium between man and the computer that facilitates all human attempts to use the computer's potential in an easy way.

User interfaces have come a long way since their first introduction. They have been evolving ever since, trying to keep up with the computer technology evolution. Even so, during all the years of user interface evolution, the user environment that they presented remained very unfamiliar to the inexperienced user. Lately a new trend in computer user interfaces has arised. This trend is the introduction of Virtual Use Interfaces and is becoming widely accepted by the computer industry.

User Interfaces for Web-based services

Definition of User Interface and its evolution

The term 'User Interface' is generally used to describe the methods and the devices that are used to accommodate interaction between machines and the humans that use them. Human-Computer Interaction consists of many kinds of interactions. A HCI takes place during the use of every computer-based system and environment such as a touch screen, an Operating System and most recently, the Web.

Human-Computer Interaction has been facilitated by UIs from the beginning of computer existence. At first the UIs were very simple and very difficult to understand. This was not strange though, since the users of almost all computers were the people who invented them. As time went by and computers became an integral part of everyday life, common people were becoming computer users. Due to this change UIs had to be improved in terms of the experience that was required from their users. Thus, the UIs were driven from the older text based interface to the Graphical User Interfaces (GUIs).

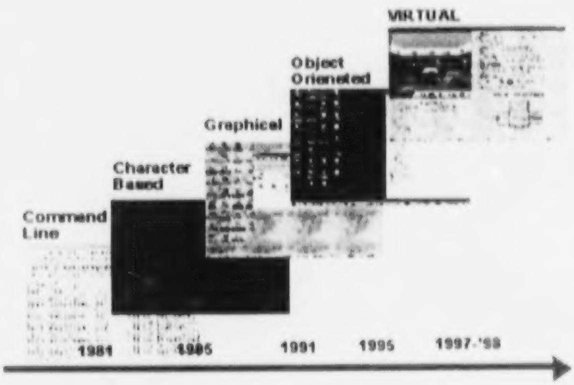

Figure 1 The evolution of User Interfaces

This family of UIs focuses on the needs of Human beings and in this way has reduced the training and experience that was considered necessary for a user to use a computer. In this paper the term 'User Interface' will be used to describe the software that facilitates the use of a Web based service and handles the interaction process between the computer and the user.

Definition of Web-based services and their User Interface requirements

In recent years the World Wide Web (WWW) is being used for all kinds of applications and communication. The wide spread use of this new means has made it very attractive to use as a platform for the implementation of existent and new services. A Web-based service is nothing more than the implementation and the provision of an already available contemporary service (such as the yellow pages) or a new service (such as a virtual library) through the WWW. The use of the WWW as a platform for the implementation of various services has many obvious advantages, such as the broadening of the range of the targeted users, but also has to face a very serious problem. This problem is the need to develop the UIs in order to help the inexperienced WWW users to understand and use the implemented web service, in other words the problem of designing easy to use Web User Interfaces (WUIs). Human-Computer Interaction is becoming Human-Web Interaction in our days and the WWW is being used really often, while its use is likely to expand even more. Thus, the need for the implementation of friendly and easy to use WUIs should be given a lot of attention by future developers.

What should a UI of a Web-based service contain

The two major characteristics of any UI that accommodates Web-based services (already mentioned as Web User Interface or WUI) must be user friendliness and user need facilitation. In other words a WUI must make the service easy to use and at the same time it must be able to attract new users. In our days, the profile of the Internet and Web user is getting closer to the profile of an every day person. Statistics show that almost one third of the citizens of the United States use the WWW and in Europe the WWW users' numbers are increasing rapidly. In order to address the user's needs, WUIs must be able to present the information required from and inserted into a Web-based service in a way that it resembles what users see and experience in the real world.

Contemporary user interfaces – An implementation instance

In order to distinguish between contemporary and virtual user interfaces, we present an implementation instance for each case. These implementation instances concern interfaces developed specifically for access to an existent Directory Service.

In the case of the contemporary user interface, a simple but functional interface was developed over the Directory Service. This interface was developed following all the existent conventions and methodologies for the deployment of WUIs. Thus, the user interface interaction cycle is [Rees 1996]:

- user clicks a command button
- browser sends state/contents of form elements to Web server
- Web server runs (CGI) script to generate new HTML page to transmit to browser
- browser displays new page

More specifically, the first page of the WUI designed contains a typical collection of Web-based form fields for the user to fill in. We reduced the amount of the information required from the user by eliminating the form fields that must be filled in. In this way, the WUI became as light as possible. Our aim was to lift the burden of the application from the user and impose it on the underlying service.

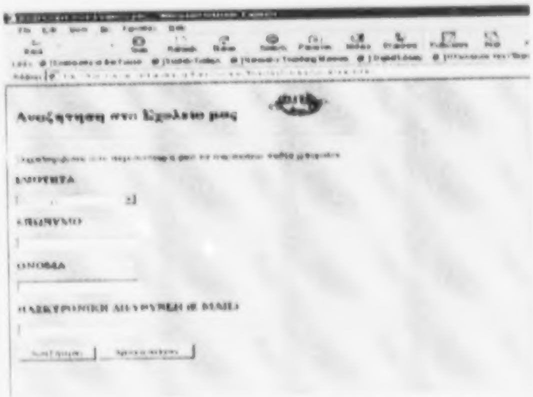

Figure 2 *The Contemporary User Interface*

We also tried to reduce the instructions towards the potential users as much as possible, as this may often be confusing and repulsive for those that are either inexperienced or in a hurry. Recent studies have shown that:

- Users don't like to read
- Text should be scannable
- Simple and informal writing is preferred
- Credibility is an important issue
- Users want to get their information quickly
- Text should be concise

Based on the above, the WUI designed retains its simplicity without compromising in terms of functionality.

The user has to fill in the forms presented to him in any way convenient to him. Keeping in mind that the WUI was developed for a Directory Service, the user can fill in the forms with either a part or the whole of the information he wants to search the Directory for. The underlying application is responsible for the error handling, thus protecting and facilitating the end user. Short and friendly error messages redirect the user to the correct position inside the WUI in order for him to re-impose his search query. When all the available information is inserted through the WUI into the service, the user has to press the submit button and wait for the interface to return the results of his search in a similarly comprehensible format.

From a technical point of view, the browser gives immediate feedback on the state of each individual interface element. Since effective user interface design requires interface elements to be tightly coupled, the selection in a drop-down menu may mean that other buttons/selections/fields should be disabled (grayed out or absent) since their existence is not appropriate for that selection. Furthermore, all information inserted before an error alert, except for the erroneous part, is preserved and reloaded in the new Web page presented to the user in order to re-submit his query. In this way, the WUI carries the responsibility for protecting the user from the redundant task of re-inserting all the necessary information, each time an error occurs.

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Virtual user interfaces – An implementation instance

Designing Virtual user interfaces

The idea of a Virtual User Interface (VUI) lies on the potential to embed Web-based services into realistic three-dimensional Virtual Worlds (VWs) [Earnshaw 1995]. The developer of a VUI should initially conceive the 'Theme' of the VWs comprising it. By the term 'Theme' we refer to the instance of the real world that is virtually represented in the VUI. Examples stemming from actual implementations, include virtual representations of Exhibition Centers, Libraries, Schools etc. Consecutively, the developer has to design and implement the necessary VWs with respect to several constraints, some of which are described below. In [Schneiderman 1997] we are presented with three central concerns that all designers of VWs should have:

- The user must be able to imagine that the world portrayed is real, by the world's behavior
- The presentation of the virtual worlds should enrich the experience for participants, so that the VUIs will not become dull end emotionally flat
- Since the user has influence on the Virtual Worlds, the creator cannot plan the exact sequence of events. Therefore, all possible situations must be anticipated and predicted during the designing stage.

Apart from the artistic effect and outline of VWs, the developer must pay particular attention during the design phase to the potentials of his VWs, so that later on all, functionalities provided by the underlying service will be able to correspond to actions in the VWs.

Important aspects concerning the design of VUIs include among others [Schneider 1996]:

- The VUIs must be productive as collaboration tools and enhancement factors for learning
- They should support multiple communication channels meeting the needs of different user groups
- They should support a large variety of media (e.g. text, graphics, sound, etc.)
- They must adapt to the users and not the other way round
- They must plan for change, growth and transformation
- They should contain objects that can be manipulated
- They can be enhanced with artificial agents or more generally can integrate Human-Computer Collaborative Learning Systems (HCCLS) with Computer-Supported Collaborative Learning Systems (CSCLS).
- They should have comprehensible and realistic navigation features
- At this point, the expansion of VWs to Distributed Virtual Worlds (DVWs) can be introduced.

DVWs allow multiple users to share the same VW, and so can be used for CSCW applications. This is so because the three dimensional nature of the shared workspace allows the policies used to manage communication and access to shared resources in traditional CSCW applications to be replaced by a more natural use of space and body language. Applications that are currently being explored include visualisation, teleconferencing, simulation, training, education and entertainment. These applications have widely varying requirements of the environment in which they are performed. According to the above, the designer of the VUI has to decide whether his product must support distributed use, based on its functionalities, and if so expand his VUI into a Distributed VUI (DVUI).

An important aspect in the process of designing DVUIs is user embodiment [Benford 1995]. By user embodiment the authors refer to the provision of the interfaces with appropriate body images representing each user in the DVUIs. Embodiment design issues include: presence, location, identity, activity, availability, history of activity, viewpoint, action point, gesture, physical properties, active bodies, time and change, truthfulness, efficiency and many more.

Description of a Virtual User Interface

Our implementation of a virtual user interface over an existent Directory Service involved the design and realization of a VW, which in our case was developed having as theme the teachers' office in a contemporary school. The VUI that we designed provides Directory Services to inexperienced users in such a way that only fundamental skills on the use of computers, such as navigating in a virtual world using the mouse movement, are required.

It consists of three unequal frames into which the Web-browser window is divided. The VW is shown in Frame 1. In Frame 2 constant text-based help to the user is provided, while Frame 3 is used for interaction between the VUI and the user. Through Frame 3 and the VW, the user enters information required from the underlying Directory Service and sees the results of his actions.

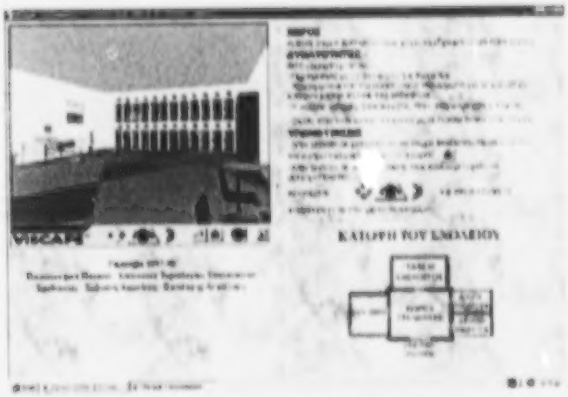

Figure 3 *The Virtual User Interface*

As the user enters the virtual room, he finds himself in front of a set of cabinets through which the Directory Service is mainly provided. The searching procedure to be followed is: click on the cabinet which holds the first letter (from A to Z) of the name of the entity to be found through the Directory Service, click on the appropriate name from the ones beginning with the specific letter, as they appear on a folder coming out of the cabinet and then receive information on the entity. This information is available in the form of a card (like a library card) coming out of the aforementioned folder. In the case of a human entity, the card consists of a photograph, information and several functionalities e.g. a button on which the user can click in order to send e-mail to the person presented. At any moment the user is able to recommence his trip in the VUI and initiate another search into the Directory Service.

Using frames in Web interfaces

The issue of using frames in web design is somewhat controversial. The most important problems are the following:

- The simplicity of the original "one page per time" web browsing may be lost in the complexity of frames
- The page may not be able to be bookmarked
- Browser URL's do not comply with the information seen on the user's screen but with the initial frameset
- Many users still use previous versions of browsers
- Print problems may occur
- Authoring problems may occur
- Search problems may occur
- Frames are against most of the users' preferences

The problems that may occur by using frames and that were mentioned above can be surpassed by the frame implementation that we propose. The basic idea is to embed the fully-functional VWs in Frame 1 and use the other two frames as 'aid-providing' frames. Since VUI implementation is not very wide spread at the moment the idea of providing a service that would consist only of the VWs might prove to be quite hazardous. The environment that we propose is highly integrated and uses frames as cooperating modules.

Advantages and Disadvantages that come with the use of VUIs

There are many advantages in using VUIs instead of contemporary interfaces in the implementation of Web-Based services. The most important advantages are mentioned below:

- The VUI approaches the real world representation of the provided service. Thus, an inexperienced user may easily familiarize with the service provided through the VUI.
- The user doesn't navigate for a long time and does not memorize some complex URL to use the service.

- Statistics show that the Web users do not want to read a lot while visiting Web pages. A VUI minimizes the reading required in order to use a service since it is not text-based but graphic-based.
- Statistics have also shown that users do not like to scroll through long pages on the Web. The use of Virtual interfaces also eliminates this disadvantage of contemporary UIs.
- Another major advantage that comes with the use of VUIs is the added value that they provide to the implemented service. VUIs can be easily enriched at any moment with functionalities.
- The VUI can easily be customized to address specific user preferences.
- The future of many technologies is for them to be integrated. In our days we are looking at the attempt to integrate the WWW with television by creating a new medium called the Web TV.
- The use of VUIs facilitates the use of the WWW as an advertising and promotion medium.

Even though there are many advantages that come with the use of the VUIs, there are still certain disadvantages that derive from the fact that the technology is still new and not tested:

- The greatest disadvantage of the use of VUIs on the WWW as we know it today is imposed by bandwidth limitations. VUIs must be downloaded to the user's personal computer first, in order to be viewed.
- Most of the VUI implementations require a plug-in for the user's browser in order to be viewed. This makes the user download the plug-in before using the VUI, something that may also discourage him.
- There are no widely accepted standards in the field of VW implementation at the moment. This may discourage big companies to use the new technology.
- The technology is not supported by many older browser versions, that many users still use.

Conclusions and Future work

In this paper we have shown the potentials of the new Virtual Environments technology and a way that it may be integrated into a VUI. It is almost certain that this technology will mature and attract more attention in the future. Its use is a good solution to the uprising demand by WWW users around the world for more Web-based services. Our future work will focus on the subjects of linking databases and making them co-operate with the virtual environment [Bouras 1998] as well as creating educational Distributed Virtual Environments (DVEs). Both of the above will raise the functionalities of such environments to such a level that many established current technologies will become obsolete and be replaced. The next step in the way of further development of the proposed VUI is to make it customizable. As in all customer/user oriented WWW services the capability for customization is a key feature that must be supported.

We must note that we are convinced that VUIs may become a new means that will bring people from different parts of the world together and facilitate people with all the services that may have been formerly not accessible.

References

[Benford 1995] Benford, S., Bowers, J., Fahlén, L.E., Greenhalgh, C., & Snowdon, D., (1995) User Embodiment in Collaborative Virtual Environments, *CHI 1995*, Association for Computer Machinery, New York, NY.

[Bouras 1998] Bouras C., Fotakis D., & Philopoulos, A., (1998). A Distributed Virtual Learning Centre in Cyberspace, *The 4th International Conference on Virtual Systems and Multimedia, 1998*, Association for Computer and Machinery.

[Rees 1996] Rees, M. (1996). Exploiting the Full Web User Interface Spectrum, *Second Australian World-Wide Web Conference, 1996*.

[Schneider 1996] Schneider, D.K., (1996). Virtual Environments for Education, Research and Life, *Workshop on Virtual Environments and the WWW, Fifth International World Wide Web Conference, 1996*.

[Earnshaw 1995] Earnshaw, R., & Vince, J., (1995) *Computer Graphics: Developments in Virtual Environments*, Academic Press, London, United Kingdom, 1995.

[Schneiderman 1997] Schneiderman, B., (1997) *Designing the User Interface : Strategies for Effective Human-Computer Interaction*, Addison-Wesley Computer and Engineering Publishing Group, Reading, UK, 1997.

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References

[Benford 1995] Benford, S., Bowers, J., Fahlén, L.E., Greenhalgh, C., & Snowdon, D., (1995) User Embodiment in Collaborative Virtual Environments, *CHI 1995*, Association for Computer Machinery, New York, NY.

[Bouras 1998] Bouras C., Fotakis D., & Philopoulos, A., (1998). A Distributed Virtual Learning Centre in Cyberspace, *The 4th International Conference on Virtual Systems and Multimedia, 1998*, Association for Computer and Machinery.

[Rees 1996] Rees, M. (1996). Exploiting the Full Web User Interface Spectrum, *Second Australian World-Wide Web Conference, 1996*.

[Schneider 1996] Schneider, D.K., (1996). Virtual Environments for Education, Research and Life, *Workshop on Virtual Environments and the WWW, Fifth International World Wide Web Conference, 1996*.

[Earnshaw 1995] Earnshaw, R., & Vince, J., (1995) *Computer Graphics: Developments in Virtual Environments*, Academic Press, London, United Kingdom, 1995.

[Schneiderman 1997] Schneiderman, B., (1997) *Designing the User Interface : Strategies for Effective Human-Computer Interaction*, Addison-Wesley Computer and Engineering Publishing Group, Reading, UK, 1997.

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The Web Forum: An Online Business Strategy for 2006

The Online Strategy

To provide a personalized and customized learning experience to our community of learners.

The Web Forum:

The Web Forum is an online education management system that combines teaching and learning systems with management and administration systems. The Forum is comprised of a variety of integrated environments for the delivery of products and services that may be accessed in flexible combination, and includes:

Learning Experiences

Web Forum is an online environment in which appropriate course components are stored for sale-on-demand. A customer may access and complete the component parts of a course or training offering to meet their personal and immediate information and training needs. The School manages the customer's learning history to identify if and when s/he has successfully completed a significant portion of an existing course or a newly identified path of study. Once a match is made between the customer and the customer's specific requirements, the customer may register and take only specific information offerings or training modules, choosing whichever ones that will result in a customized experience.

Off-line Course Enhancement Environments

The Web Forum online environment is a repository which stores course enhancements and may include URLographies, reading lists, course outlines, weekly course updates, chat rooms, news groups, threaded discussions, educator/facilitator/mentor access, etc.

Dynamic Educational Links Database

The Web Forum is an online educational resource storage environment where links are indexed --by the School's program directors, by the instructors/educators/facilitators, and by the learners-- for quality and relevance. Course or learning module-developers may select appropriate links through keywords and references. Auto-check of link validity is a feature of this database. Access to this environment is available to learners or subscribers.

Course Environment

Web Forum is an online environment that hosts courses and learning offerings. It is also an environment where learners manage and/or complete their learning.

New Course / Instructor Environment

Web Forum is an online environment in which instructors may propose new courses and learning modules. Course or module proposals may be posted for marketability and need not be developed until interest is high.

New or Potential Learner Environment

Web Forum is an online environment in which potential learners may browse and sample courses and learning modules. They may peruse existing and potential course and module offerings, and identify what they would like to learn, including the medium of delivery, the language of delivery, the timing, etc. This environment dynamically manages waiting lists by identifying growing interest in courses and learning modules through automatic notification to all stakeholders.

Instructor/Facilitator Development Environment

Web Forum is an online environment in which instructors/educators network with peers, and exchange tips and hints for managing adult learners' needs and learning style preferences. This environment is also the medium of delivery for instructor/educator/facilitator professional development.

A Summary of the Context in which a Course or Learning Offering May Be Integrated into the Web Forum

The critical success factors in the delivery of learning, in 2006 and beyond, will be the provision of personalized and customized learning experiences through the management of educational systems and the re-framing of the adult educator mindset. Learning organizations will be in the business of offering well-defined and parameter-driven personalized customer services to learners and will be managing the expectations of learners and the relations of learners and their adult educators.

Technology will provide us the opportunity to move us closer to achieving a pedagogical ideal. Online learning of the future will create a set of new assumptions about online learning delivery:

- ***Learner care.*** Technology provides us with the opportunity to finally meet an individual's education needs. Learning organizations that provide, with guidelines, personalized adult educator response, feedback and customer service will have higher online program completion rates, higher learner satisfaction ratings, and higher learner retention. Learning organizations will have a repository of learner data and learner-educator interactions so that fine-tuning of online education delivery is possible.
- ***Multiple touch points.*** Learning institutions will assure consistency and quality of educator-learner communications across the multiple touch points of telephony, i.e., e-mail, asynchronous and synchronous web-driven interactions as well as traditional communication channels.
- ***Personalize, personalize, personalize.*** Learning institutions and adult educators will devise flexible communication systems to manage learner expectations and achieve cost efficiencies while leveraging educator-learner contact, within parameters, to optimize the online learning experience.

Learners will come to expect and enjoy optimized learning experiences due to learner-educator interactions that will occur, with parameters and ground rules, across multiple touch points. Adult learning principles will be mined to serve professional education and continuing education learners and customers and will be applied in the form of personalized learning solutions and services offered in a communication system, the ground rules of which may vary from institution to institution, from adult educator to adult educator, and from offering to offering.

Adult learners will be treated as customers. The flexibility, customization and work with the adult learner "in the way that s/he prefers" will drive effective online pedagogy by 2006. The adult educator's attitude is key. Tremendous flexibility within the learning experience will be the international standard. With the customer service attitude of the adult educator as paramount, learning environments will evolve iteratively.

Learner-centered offerings will require adult educators to shift their priorities and their roles. The primary requirement to achieving effective online education will be that adult educators make this shift. Of equal importance, the roles and expectations of all stakeholders in the management and administration of this environment will require re-definition and alignment.

Towards a Pedagogical Ideal in 2006 – from the Online Learners' Perspective

We will present, from the on-line learner's perspective, where online learning has been, its shortcomings, and how we as adult educators may shift and move more fully toward a menu of pedagogical ideals, as facilitated by the solutions which Web Forum provides.

Shortcomings:

- There is a lack of personalized feedback from the adult educator to learners' queries, their assignments, their tests and exams. Outcomes: Even higher drop out rates for online courses in comparison with paper-based distance delivery. What is desired: personalized communication in order to progress in the learning process and maintain motivation to complete the program.
- There is a lack of multiple touch points (communication channels). No e-mail, fax or phone communication permitted between adult educator and learner. Where contact is permitted, technical complexity and difficulties have made the learning experience unfriendly.
- In first generation online courses, learners complain that they are simply lecture notes or a "text only" presentations thrown up on a website.
- There is a dearth of adult educators who have a passion and a desire to "deliver it right" online, or in other words, a desire for learner-centric delivery. (Both institutions and learners agree on this issue.)

Web Forum Solutions:

- With your adult educator and facilitator as personal guides, you will discover the subject matter in greater depth under the guidance of an expert adult educator and facilitator who will help you stay focussed.
- E-mail communications with your instructional team are strictly confidential, which means you can be comfortable raising sensitive issues in a confidential, secure environment. There will be an adult educator and a facilitator from within the institution as part of the learner support network that includes: technician, expert adult educator, facilitator, and peer communication support.

Shortcomings:

- Learning technology support requires reasonable parameters and funding to support the "help desk" infrastructure. The layering of help desk support is a key to the answer.

Web Forum Solutions:

- "Just-In-Time" help from your expert adult educator and facilitator responds to your particular needs and schedule, within reasonable timeframes. Contact your expert adult educator and facilitator by e-mail, phone or fax with questions about the content, or how to apply it as you learn, and you will receive answers and feedback in a timely fashion, usually within three to six working days. By having a learner support network, this will let you, the learner, understand and distinguish between the variety of your needs and will allow you to be discriminating in the selection of your support requests based on the communication network we offer. (Please see the Leadership Online example at end of this section.)

Shortcomings:

- Complaint: Educators are not paid for their web delivery time ("I'm checking for learners' e-mails at 2 am on Sunday mornings", etc.).

Web Forum Solutions:

- The learner will have better access to personalized feedback from adult educators, with reasonable parameters. Online communication does not mean instantaneous response. "It's not No, it's just NOT NOW." These include learners becoming familiar with the follow-up and response times arranged by the adult educators and the institution's support network. Learners' expectations will be managed and met by the communication network set in place by the institution.

Shortcomings:

- The following are types of required assignments and learning activities that have been known to fail with adult learners: required team chats, team projects & team assignments via email with attachments. In addition, first generation online courses are often packed with too many assignments (avg.12+ hrs/wk/course) in comparison to the equivalent in-class program. Matching and branching processes are needed with respect to the type of program (i.e., hard skill or soft skill training) and the degree to which content will drive the degree of flexibility and choice of activity.

Web Forum Solutions:

- Complex, excessive "busy" work is out. Learning activities are doable and reasonable within the given timelines. You will be able to balance learning projects against the constraints of time, space, economic resources, and personal and professional relationships. Your online experience for assignment completion will be feasible with a moderate to high comfort level.
- Easy Access, Anywhere, Anytime: You mine the discovery hub and information repository of the Web Forum (as well as the Web) for your needs.
- Each educational skill area will be delivered through its own password-protected website containing carefully selected digitized learning materials, including access to a collection of vetted online resources.
- You'll want to visit the identified online resources after your program has concluded, for continued learning.
- In Web Forum, the variety of online tools will include reading material and the website's "discovery hub" of high quality, hot-linked URLs.
- The course website area within Web Forum will be the communication conduit for e-mail to your coach and peer networking. If you can connect with a web page, you can connect with the course.

Shortcomings:

- Intellectual property issues have not been sorted out. Several instances: For a brand new online course which adds to the department's existing curriculum portfolio, the educator develops content, and is paid outright because the department purchases the intellectual rights to it. ("The professor takes the money and run.") In these instances, the institution holds the copyright and does not expect to see its investment paid back within the next decade.

Web Forum Solutions:

- The Leadership Online course example within the Web Forum model is based on rights to intellectual property, not outright ownership of the course content. Access to these rights is due to a cooperation, not a competition model. Adult and professional education are differentiated markets from that of the University proper. The cooperation model was made possible by selecting an existing program designed for the corporate marketplace. With a view to cooperating in the expansion of market outreach to the general adult population, the intellectual property owner was attracted to the University's ability to serve differentiated markets and thus was willing to sell rights to the program for online, paper-based distance and classroom use.

Shortcomings:

- Adult learners online identify an immediate need or work-related problem that is relevant within the context of the course, but solutions are time consuming or go beyond the immediate need and strictly defined course objectives. Learners have a variety of learning styles and needs and often find it nearly impossible to schedule an in-class distance learning, or online course.

Web Forum Solutions:

- The learning experiences environment provides Just-in-Time learning based solutions, which, when combined with other learning experiences, form a module or course and deliver pedagogical outcomes.
- This new and potential learner environment provides a dynamic waiting list segment allowing them to identify what, when, where, and how they prefer to learn.

Shortcomings:

Personal computers are subject to crashing and Internet connections cost most users money

Web Forum Solutions:

The strategic design of courses and learning experiences minimizes the time learners spend on-line by providing download options to work offline.

Shortcomings:

Learners have specific interests and needs arising from a course of study and would often enjoy access to and guidance from other resources on a specific topic.

Web Forum Solutions:

The dynamic educational links database environment provides learners with the opportunity to self-direct their study path moving beyond the boundaries of the traditional syllabus, and provides them with the opportunity to share their intelligence and experiences with others.

Conclusion

The Web Forum delivers optimal learning environments and value to the customer. It may be deployed without major investment and prepares the institution to benefit from the projected $17 billion market in 2006 while delivering learner-centric education opportunities.

References

Barrie, M. C., & Howarth, L., (1997). *Carrier Pigeon Project*, 1997, University of Toronto, School of Continuing Studies & Faculty of Information Studies, Toronto, ONT.

Leadership Study of Canadian Business, 1996, University of Toronto, School of Continuing Studies and Performance Challenges Corporation, Toronto, ONT.

Using 3D to Support Awareness in Virtual Teams on the Web

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Abstract: During the last few years several Internet based 3D environments have been realized. Many of them provide a virtual environment for chatting, talking, and the representation of users by avatars. Such shared virtual worlds however, have not yet found their way into the daily office work. They are rather used for gaming or private meetings.

In this paper we will show how shared 3D environments can be used in an office environment. We will introduce a sample scenario based on our toolkit for shared virtual reality applications to demonstrate how such environments can successfully be used to support members of virtual teams.

1. Introduction

Internet based shared virtual environments have been around for some time now. Examples include ActiveWorlds [www 1], Blaxxun [www 2], or Sony's Community Place [Lea et al. 1997]. However we can observe that after the initial enthusiasm such environments often become less and less attractive to the users and finally grow lonely completely. People only return for particular events scheduled in advance. Most of the remaining time however, these worlds are sparsely populated. The reason for this development is not the quality of the software available or the design of the particular virtual worlds but rather the missing purpose of such worlds. Most of these worlds were created to provide a compelling and interesting environment for chatting and meeting people on the Internet. While this seemed to be a good idea on the first glance, long-ranging it did not seem to attract a significant number of users (especially when compared to classic chatting environments such as IRC). Due to improved support for 3D rendering on most computers today, graphics performance usually is no longer an issue. Nevertheless people enter a 3D world, navigate through the scene, and often already leave after a few seconds. People avoid such worlds, if there is no significant new information compared to their last visit. This situation is not really improved by providing the user a possibility to modify the world interactively as ActiveWorlds shows.

In contrast to these observations networked 3D games have recently become very popular. Some of them such as Ultima Online [www 3] attracted thousand and thousand of users over a period of several month. We can identify a number of reasons for this:

- each participant has to compete against other users
- the number of competing users is always rather high
- even if there are no other users in the same area of the virtual world, the environment is challenging for the participant
- the 3D environment is very dynamic - players visiting the world often and for a long time have advantages over users spending only a few minutes in the environment

Games however are used (or at least should only be used) in the user's spare time. They require one hundred percent of the user's attention. This also applies to existing Internet based virtual environments. This has a significant impact on the use of shared virtual environments within a regular office environment. One possibility would be to let the user switch between his regular working environment and the 3D environment. This method can be used for scheduled meetings only. Additionally the usability of the 3D environment is limited to a small set of applications which can take advantage of a 3D representation of objects or users. It can for instance be used to enhance the communication between distributed users without the high-bandwidth requirements of video conferences by supporting the transmission and representation of the users' gestures and body language. The goal of this paper however, is to show how 3D worlds can be used in a non intrusive way to support regular office work.

In this paper we present our approach to use 3D for supporting mutual awareness in distributed teams on the Internet. In the second section of this paper we will give a brief introduction of the infrastructure our application scenario is built on. In the third part we will finally show how this infrastructure can be used to create a 3D environment to support virtual teams.

2. Technical Infrastructure

In this section we present the basic infrastructure we have realized to support the development of distributed virtual reality applications on the Internet as well as the mechanisms to achieve awareness of events. Our approach is based on following three basic technologies:

- a universal toolkit for creating shared virtual environments on the Internet
- a set of software and hardware sensors to create new interfaces to gather data about user and object states
- a basic awareness infrastructure used to process and filter the captured data and make it available to other applications

This infrastructure presents the basis for the application scenario created to support distributed virtual teams.

2.1. SmallTool

Our sample applications are based on our SmallTool multi-user VR toolkit [Broll 1998]. *SmallTool* consists of a set of libraries to minimize the effort required to create distributed virtual environments for the Internet. The toolkit supports the creation and maintenance of shared virtual worlds populated by users and animated characters.

The main parts of *SmallTool* include:

- EV - the extended VRML library
- DWTP - the distributed worlds transfer and communication protocol
- DICI - the device independent communication interface

These *SmallTool* libraries are currently available for Windows95/98/NT, Linux and some UNIX flavors (IRIX, SOLARIS). For performance reasons all libraries are realized entirely in C++. The rendering part of the extended VRML library is based on the OpenGL graphics interface available for all major platforms.

We have built some sample applications on top of the *SmallTool* libraries. Our main application is SmallView, a multi-user VRML browser. It allows us to share virtual worlds among several users and to represent users by avatars. Additionally it provides various input and application programming interfaces.

The *SmallTool* distributed VR toolkit supports VRML by its extended VRML library (EV). VRML'97 [Ames et al. 1997] is the ISO standard for 3D objects on the Internet. The extended VRML library can be used to read and write VRML files and to manipulate and render VRML objects. In addition to the features defined by the VRML standard it provides support for the representation of users by avatars and the synchronization of multiple scene data bases. The latter feature can be used to keep several distributed copies of a shared virtual world consistent. The synchronization events are generated automatically upon object changes and the VR application just has to sent them to the scene data base of other participants - either directly or via a central server. These mechanisms provide the basis for distributed multi-user virtual environments.

SmallTool uses DWTP - the distributed worlds transfer and communication protocol for all network communication specific to shared virtual environments. DWTP is an application layer Internet protocol - similar to HTTP or FTP - tailored to the needs of distributed multi-user virtual reality applications. In contrast to simple web pages, such applications usually require different types of data to be transmitted:

- files, containing the description of the scene or the avatars
- events and messages for updating and synchronizing distributed copies of shared worlds
- streams containing audio or video data

Additionally connection types between the participants are not limited to reliable one-to-one connection (as used for HTTP). One-to-one connections can be used along with one-to-many or many-to-many connections or both reliable and unreliable internet protocols. DWTP hides the underlaying protocol from the VR application and provides a simple, high-level interface to transmit and receive data of the types listed before. In addition to its client interface, it provides a number of services which can be used as daemons or within application servers to realize scalability, reliability and persistence for distributed VR applications.

The device independent communication interface (DICI) finally supports the easy connection of new innovative I/O devices via the Internet. Each I/O device is connected to a DICI server part, which makes the device available to all or selected hosts on the Internet. Applications which want to use these services (either receiving input data or sending output data) simply include the DICI client interface. The services can then be used by specifying the Internet address and the name of the requested service. We have realized DICI servers for 6DOF magnetic trackers and the MOVY tracking system [Henne 1999].

2.2. Collecting User Data from Sensors

A major requirement for the support of awareness in distributed teams is the possibility to collect data about the current activities of the individual user. Existing input devices such as mouse and keyboard are not sufficient for this purpose. In order not to disturb the user during his regular daily work, it is important to use non-intrusive methods for the collection of the user specific data.

2.2.1 Hardware Sensors

One hardware sensor used to detect user actions is the MOVY tracking system. MOVY is a wireless inertial tracker developed in our institute. Compared to magnetic tracking devices it has a wider operation area and is not influenced by metal or electric fields. Further more it does not require any fixed base installation in the environment.

Depending on the location of the sensor, different types of user actions can be tracked by MOVY:

- mounted on the user's forearm, gestures of the user can be detected
- located in the user's pocket or attached to his upper leg, basic body movements such as *walking, sitting, and standing* can easily be recognized
- mounted at the chair in a user's office, it may be used to detect whether the user is sitting on the chair and whether he is looking to the screen (depending on position and orientation of the chair).

Other hardware sensors currently used to gather information are

- light barriers mounted at doors of several rooms to register people entering or leaving the room
- noise sensors to register the activity level of people in a room
- web cams to identify the location of users

Hardware sensors can be both personal or anonymous. Which type of sensor to use and how to handle privacy issues depends very much on the people involved and the type of application.

2.2.2 Software Sensors

Software sensors can be used to detect the activity of user by monitoring his keyboard and mouse input, and observing the applications and files currently used. A background process continuously captures all input events (keyboard, mouse, switching focus, etc.). These events are then aggregated to receive an activity level for the user or the particular computer. For privacy reasons the data might be forwarded anonymously.

Beside the capture of general system information, events can be created by the individual applications. This does not necessarily require any modification of the original program, in a MS Word document for example, this can simple be done by using an appropriate macro which could be part of the standard document template.

The data captured by the various hardware and software sensors is always processed locally. It is made available either by a DICI server connected to the input driver or it is converted into events sent to the NESSIE environment.

2.3. The NESSIE Awareness Environment

The NESSIE - awareNESS envIronmEnt [Prinz 1999] is a infrastructure for gathering, filtering, and distributing events. It can be used to achieve awareness on other users, web pages, or arbitrary other events. The interface to send events and to specify requests is based on simple HTTP requests, making it possible to access NESSIE from every application providing web access. Events are sent to a regular HTTP server which then forwards these messages to the NESSIE server. The NESSIE server saves, filters, and aggregates the event information and makes it available to applications upon request. Sample applications have been developed to create and to present NESSIE events. The content watcher application for example monitors web pages or specified parts of it and sends an event to the server, when the content has changed. The ticker tape application allows the user to visualize events received from the NESSIE server on their screen.

An often discussed awareness issue is the danger of misusing awareness information for control purposes. We address that problem by the introduction of event access rights and the disclosure of interest that others have registered in events that a user generates by the interaction with shared objects.

An event that is submitted to the NESSIE server can be protected against unauthorized access by the inclusion of an access control attribute. This attribute lists the ids of users or a group of users who are allowed to receive that event. This enables the server to perform an access validation on protected events. If the identified user is member of the access control list, a protected event is forwarded to the respective NESSIE client. With the introduction of access control for events the awareness environment ensures that activity information can be made visible to a restricted group only.

Although access rights are a suitable method to restrict access to awareness information, it can not guarantee to exclude misuse. An approach to address that problem is the provision of reciprocity. This is achieved by disclosing those users who have registered interest in an event to those users who produce the event - *when you see me I see you*. Whenever an event is submitted to the NESSIE server this information can be requested by inclusion of a special *observer* attribute into the parameter list. The return information lists those users who will receive that event instantly and those who are potential recipients.

This information is useful not only for the support of reciprocity. It further informs a user about the list of people who will become aware of the activity that is indicated by the event. This is important when a certain reaction is expected on the activity that raised the event.

3. Awareness for Distributed Teams

Before we introduce our approach to support distributed teams, let us have a short look on office work of teams. Usually members of a team meet from time to time to present their work, exchange results, discuss the future activities, and distribute new tasks. The co-workers then return to their work places, which are distributed over several rooms, floors, buildings, or even locations. Some colleagues may even work from home. In the time between the meetings people are usually not aware of the progress. One colleague could have updated or replaced a shared document, another one could have been hindered to finish a particular task. Some people could decide to have a spontaneous unscheduled meeting to discuss a particular aspect or problem in more detail. Most other team members will not become aware of such actions. They could be informed by their colleagues by telephone calls or by email. On the one hand this would produce a significant communication overhead and for that reason prevent spontaneous actions. On the other hand everybody would be flooded with information about activities of other team members, thus impairing his own work significantly.

The goal of our approach is to capture such actions and to make them available to the team members by addressing their peripheral awareness. Existing approaches to this problem send an email or pop up a window on the user's desktop. This however, seems to be too intrusive to achieve a peripheral awareness of the environment. In our opinion it is important to provide additional peripheral awareness similar to BT's Contact Space or Form Meeting Space [McGrath 1998].

3.1. Visualizing Activities and Team Members

Our approach therefore is based on a comprehensive virtual working group scenario including the representation of users by active avatars, appropriate visualizations of the users' real working environment (e.g. offices, coffee room) as well as virtual workspaces. These virtual workspaces may be used to represent sub-teams or subject related data.

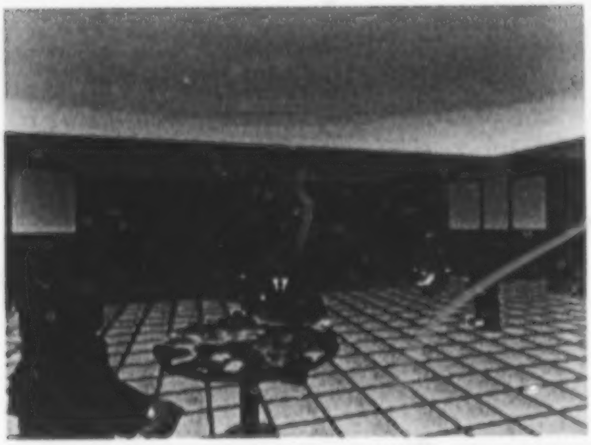

Figure 1: Awareness for distributed working groups

Within these working group scenarios each member is represented by an animated avatar. The avatar's behavior represents the activity of it's owner symbolically. If an employee opens a shared workspace and fetches a document, his avatar moves to the room representing this workspace, takes a paper out of a bookshelf, moves back into his office, sits down and modifies this document. If two users are talking in the coffee room, their avatars also move to the corresponding virtual counterpart.

In our prototype we use our VRML browser *SmallView* to visualize the activity of users in BSCW shared workspaces [Bentley et al. 1997]. Currently the system recognizes only a small set of user activities and maps them to symbolic actions of the corresponding avatar [Fig. 1]:

- an avatar moves between several rooms, depending on the current BSCW workspace the user is working on
- viewing a document (i.e. downloading it from the BSCW server) is represented by an avatar reading a book
- users working on documents are represented by a sitting and writing avatar
- an idle user is represented by a sleeping avatar

In order not to disturb the user during his regular work, in our sample scenario the 3D representation of the office environment is not displayed in a window on the user's desktop but on a separate screen. Another possibility would be to project it on the wall behind the user's monitor as a virtual 3D wallpaper. This however requires a high quality projection system usually not available in a regular office and especially not at home. This approach however allows the individual user to focus on his regular work, while always being aware of the overall situation in his working group.

To recognize the user activities the hardware and software sensors described earlier are used. Additionally software events can be generated out of the BSCW system, when users browse through different workspaces, download or upload a document, or modify other object properties. Editing a downloaded document can for instance be recognized via appropriate software sensors. To recognize whether the user is still working in his office, moving over the floor or is standing in the coffee room having a talk, the MOVY inertial tracker, web cams, and light barriers are used. For most sensor data, including the software events created by the BSCW system, we use the NESSIE awareness environment for collecting, aggregating and distributing the data. Raw MOVY data is transmitted directly to the SmallView browser using the DICI device interface.

The 3D-representation of the working environment allows remote users to achieve almost the same peripheral awareness as if working within the same office integrating them into their regular working team. Since the 3D worlds generated by this approach are diversified and expedient for the individual user, they do not leave this worlds after a short period. Nevertheless it is required to display the 3D environment on an additional screen or projector to ensure the user can still do her regular (2D) work on her regular desktop environment.

3.2. Privacy Issues

Applying the access control mechanisms provided by the NESSIE infrastructure, access to the 3D world is restricted to those users who share the displayed context. For that purpose all events that are generated by actions on the BSCW workspace objects contain an access control attribute that lists all workspace members. This guarantees that only users who share a workspace are allowed to view the 3D world. However, although the access control mechanism restricts access it is still possible to observe a world by running the 3D client without participating in the world, i.e. without actually working in any of the visualized BSCW workspaces. We do not want to suppress that possibility, because users who share a context without being actually active, should still remain aware of ongoing activities. To address this issue, the reciprocity mechanism is used instead. This functionality of the awareness infrastructure provides information about those users who have currently registered interest in specific events. All users who view the NESSIE world, i.e. who have registered interest in the corresponding events, without being active in a shared context, are represented as lurking ghosts in the 3D world. Thus it is possible for everybody to recognize the presence of observers. This again realizes the principle *when you see me, I see you*.

4. Conclusions and Future Work

In this paper we presented our approach to support distributed working groups on the Internet. We showed how 3D environments can be used to enhance the daily office work of the distributed team members rather than providing an isolated meeting place.

In our future work we will include further work on more sophisticated hardware and software sensors to provide appropriate information on the user's activity. We will additionally enhance the representations of users and support new objects, such as a printer or coffee machine, to provide a richer information to the individual user. Beside these technical improvements, privacy issues require a further investigation.

5. References

[Ames et al. 1997] Ames, L.A., Nadeau, D.R. & Moreland, J.L. (1997). *The VRML 2.0 sourcebook*. NY: John Wiley & Sons.

[Bentley et al. 1997] Bentley, R., Appelt, W., Busbach, U., Hinrichs, E., Kerr, D., Sikkel K., Trevor, J., & Woetzel, G. (1997). Basic Support for Cooperative Work on the World-Wide Web. *International Journal of Human Computer Studies: Special Issue on Innovative Applications of the World-Wide Web*, No. 6, 827-846.

[Broll 1998] Broll, W. (1998). SmallTool - A Toolkit for Realizing Shared Virtual Environments on the Internet. *Distributed Systems Engineering, Special Issue on Distributed Virtual Environments*, No. 5, 118-128.

[McGrath 1998] McGrath, A. (1998). The Forum. *SIGGROUP Bulletin*, Vol. 19, No. 3, ACM Press.

[Henne 1999] Henne, P. (1999). MOVY - Wireless Sensor for Gestures, Rotation and Movement. *ERCIM News* No. 36. Le Chesnay Ledex, France: European Research Consortium for Informatics and Mathematics.

[Lea et al. 1997] Lea, R., Honda, Y., Matsuda, K., & Matsuda, S. (1997). Community Place: Architecture and Performance. *Third Symposium on the Virtual Reality Modelling Language 1997 (VRML'97)*. ACM SIGGRAPH, 41-49.

[Prinz 1999] Prinz, W. (1999). NESSIE: An Awareness Environment for Cooperative Settings. *European Conference on Computer Supported Cooperative Work 1999 (ECSCW'99)*, Copenhagen: Kluwer Academic Publishers.

[www 1] ActiveWorlds. http://www.activeworlds.com

[www 2] Blaxxun Interactive Inc. http://www.blaxxun.com

[www 3] Ultima Online. http://www.owo.com

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"Don't Forget the Teachers!": Evaluating the Impact of IT Integration into a University Curriculum"

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Abstract

In this paper, we report on the findings of two surveys, one year apart, into the experiences and attitudes of teachers in a university English-teaching unit to the prospect of a curriculum increasingly mediated through information technology. The responses bear witness to the problems teachers experienced in attempting to computerise their pedagogical practices, and show how issues of technology, workload and support in the end can contribute to levels of anxiety and resistance in the workplace. By the end of the 2nd year, a few teachers remained skeptical that computers can enhance language teaching, but any remaining apprehension regarding IT tended to be focused on real administrative and logistical problems of implementation. The paper concludes with recommendations to institutions seeking to pursue the path of integrating IT into well-established curricular practices.

Introduction

The thesis of this paper is that, before they start throwing money at computerising their students' learning environment, educational institutions need to create the right pre-conditions - in terms of both technological and pedagogical support and staffing and hardware infrastructure. This paper discusses an initiative at the University of Hong Kong which involved the English Centre being funded to take a lead in integrating information technology (IT) into all of its first-year curricula. The rationale was that the English Centre alone had access to all 3,000 incoming students via its compulsory courses in English for academic and/or professional communication courses. Our own incentive was the opportunity to pursue the educational goals of providing richer, more individualised and more interactive language learning resources for our students. We were also providing a service the university was expressly asking us to provide, a novel situation which contrasted with the climate of under-appreciation we had been experiencing over the past few years.

Over the past two decades, CALL and CMC[1] have become accepted sub-disciplines of language teaching and applied linguistics. Much work has been done on strategies and techniques to harness technology to pedagogy, whether for program delivery or as ancillary resource: cf. Star Roxanne Hiltz' recent book on the Virtual Classroom (1994) and, in CALL/CMC specifically, earlier work by John Higgins (1988), and more recent American work by Mark Warschauer (1995) and Selfe and Hillgoss (1994). However, much of this work assumes an audience of teachers converted to the cause of CALL/CMC; any problems of implementation tend to be constructed as learner problems. Less common have been discussions of the problems of bringing a large body of teachers up to date with IT in institutional settings: problems of familiarisation, workload, training and back-up support resources - and of alienation. Those papers that have cautioned against the uncritical pursuit of computer-base learning and teaching have tended to focus on the students. Deming wrote of Word Processing "apprehension" back in 1987, and more recently (1994) Hiltz has used the term "*electronic anomie*", but neither were identifying a problem that might afflict teachers. At the University of Illinois-Chicago's English Department, Sosnoski et al. (1997) were concerned about the effects of IT on teaching practices and the teacher-student relationship, and launched an investigation into the possible implications for writing programs across the curriculum (the Tic-Toc Project [2]). More recently still, Hara and Kling (1999) noted the absence of a social dimension to discussions of students' problems with computer-mediated education, and noted strong threads of frustration, notably at the lack of teacher response. Findings like these point to an underlying problem area equally under-researched: the practical and philosophical difficulties experienced by teachers.

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[1] CALL = Computer-assisted language learning; CMC = Computer-mediated communication. CMC is now regarded as the more contemporary term, as CALL's notion of "assistance" is seen as too weak a term to describe the pervasive role of computers in modern communication.

In this paper, we report on the findings of two surveys, one year apart, into the experiences and attitudes of teachers in a university English-teaching unit to the prospect of a curriculum increasingly mediated through information technology. These surveys were conducted as part of a larger project, OACES, whose aim was to provide an environment and support for both teachers and students in the teaching and learning of academic communication skills. Specifically, this paper addresses the problems our teaching unit has experienced in attempting to computerise our pedagogical practices, and how issues of technology, workload and support in the end can contribute to levels of anxiety and resistance in the workplace.

Last year at Hong Kong University (HKU), the University administration decided to opt for a Laptop campus as a means of bringing curricular delivery into the 21st century. There were reference models in the USA – Wake Forest for one – but at HKU practically none of the University's curricular programmes were being delivered over the Internet (or Intranet). However, once institutional administrators begin looking at the economic advantages of switching to computer-based delivery of programmes, they can underestimate the resources needed to effect such wholesale changes in teaching practices – and the kind of affective fallout that can result. In effect, many teachers have seen in this development a pernicious extension of the automation of economic sectors to the field of education, a public service intended to yield long-term rather than short-term benefits for society. Already this institutional scale of the change being mooted has begun to produce a literature addressing the sociological and political implications and effects of such dramatic changes in our social and educational behaviour and environment (e.g. Leigh Star, 1995).

This study begins by describing HKU English Centre's attempt to integrate IT throughout its curricula. We saw an opportunity in this institutional imperative to help realise some of our own pedagogical goals, e.g. increasing the reliance on Word Processing, which we had made a requirement for students' assignments long before most other departments. We also felt we should take the opportunity to show the university that we could contribute significantly to the undergraduates' education, at a time when our funding was being pared down to the wire, and scheduled for more cuts over the following 2 years.

Background: Previous Initiatives and Pilot Experience

For early background, see the report of the 1st survey (at http://ec.hku.hk/njbruce/OACESSurvey.htm). The emphasis from the beginning has been almost equally on both students and teachers, with interaction and feedback envisaged as being more important than delivery, with a sense that our teachers needed to be brought "on side" before we could concentrate on catering in any detail to our students' language learning needs. We decided to begin with areas which would be of help to our colleagues, rather than areas which might be seen as adding to their workload.

This original plan of action was overtaken by events in early 1998, when the University decided on its Laptop campus and IT-integration strategy. Some of us (the authors, David Nunan and Phil Benson,) put together a proposal to the University that emphasised our unique exposure to all 2,700 incoming students (the ones who would have the Laptops). We proposed that the "Integration of CMC into English Enhancement courses" project would focus on the following areas:

- Design and implementation of course and class web sites as a focal point for students' CMC work
- Design and implementation of CMC-based curriculum tasks and resources

We also recognized that integration of CMC into English Enhancement courses across the 1st-year program presupposed a degree of technical competence on the part of students and staff. Our development plans therefore needed to take account of an initial need for web-based support materials, ongoing consultation for individual students and training and support for staff. The earlier-initiated OACES project continued to provide the infrastructural support for the English Centre's IT Integration [for an overview of this project's evolution and current focus, see URL: http://ec.hku.hk/njbruce/oacestable.pdf], but we were concerned that this latest development take account of the impact it would have on teachers' lives. Hence the concern to monitor teachers' reactions throughout this period.

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[2] A report on their experience is viewable at http://www.uic.edu/depts/engl/projects/tictoc/descript.htm

The Pilot year: innovation and support

In September 1998 we embarked on the pilot year of IT integration, with two funded projects to help us in that endeavour: the IT Integration Project (ITIP) and the *WebRight* project. The IT Integration Project, funded by the University, began in early 1998, and provided technical and pedagogical staff to develop 2 web-based academic and a professional communication courses for 500 1st-year Arts faculty students. This project was mainly concerned with exploring new web authoring technology while putting together materials for up to 20 teachers, since a majority of teachers in the English Centre taught on one or both of these courses. The project also continued staff training in developing websites and authoring interactive tasks for the Web. The staff coordinating and training on this project excluded themselves from this survey.

The *WebRight* project, which we started in April 1999, was initiated in recognition that we lacked the resources to spread the efforts of the ITIP team to cover the other 24 courses that needed attention. For a range of reasons, we felt that a further bid for funding needed to be a modest one. Our solution to aiming for a low-cost, high-impact proposal was to budget for student research assistants. This also led us to realize the benefits for undergraduates of being trained to author websites. We proceeded to recruit 12 students to work as a team in collaborating with course coordinators and "IT reps" for the many courses, to develop websites for the 1999/2000 academic year. The 2nd questionnaire was circulated in the middle of this project, when many of the respondents were actively working with the student R.A.s to develop websites for their courses. We hope to be able to find further funding to continue each of these projects, as our regular funding barely covers the direct teaching we have to do.

Exploring Colleagues' Experience and Perceptions of IT Integration

In May 1998 and again in May 1999, we sent a Web-based survey questionnaire to all 34 teaching colleagues in the Centre, asking a range of questions about their experience of, and attitudes to, computers in education. The only difference between the questionnaires was that the final few questions of the follow-up survey necessarily asked for retrospective post-hoc feedback. Our first survey (May 1998) showed that for some teachers the proposed integration of IT presented an exciting prospect, while for others it loomed more threateningly. For a review of the findings of the 1st survey, and a copy of the questionnaire, see http://ec.hku.hk/njbruce/OACESSurvey.htm. In May 1999, we distributed a second follow-up survey, to find out how teachers had coped with the first full year of the demands of teaching in an IT-integrated curriculum (the year's teaching finished in April 1999).

Study and Findings from the 2nd survey (May 1999)

The same number of colleagues as last year, 18 (53%), responded. Up to half the respondents in the 2nd survey may not have completed the 1st survey, so comparisons need to take account of this variable. 6 respondents chose to submit anonymously, while 12 accepted the invitation to be contacted for follow-up interview. The 18 teachers had taught an average of 3.4 different courses over the year, from the full range of our pan-university activities: Engineering, Science, Social Sciences/Business/Economics, Arts, Law, Medics , Computer Science, Economics, Architecture and Dentistry.

We again elicited information about the length and nature of their experience using computers in EFL, and then their attitudes and perceptions regarding the benefits and problems. The data on experience held no surprises: as in 1998, colleagues had more experience with older forms of computer uses, like Word Processing and CALL authoring programmes, and over the trial year had inevitably gained experience with more recent modes of delivery like the Web. The more interesting data – and what we shall focus on in this paper – came in the 2nd part of the survey, when we asked teachers about their attitudes to the role of IT in their curricula, on their confidence levels with various IT media, and about their views on the prospects for future developments.

In May 1998, confidence had been predictably higher with the more familiar, well-established forms of IT, with the exception of CALL programs which could range from technologically demanding programs to simple authoring packages. 5 of the 18 teachers interviewed expressed concern about their competence to handle Web authoring tasks, as this was being touted as the most high profile part of the IT Integration project. Interestingly, on a 1-5 scale, there was a fall in the mean among the 18 respondents in two significant areas. When asked about how confident they were that they would be able to handle classroom activities involving *authoring Web pages*, the mean fell from 2.8 prior to the pilot year to 2.4 at the end of it. *Using PowerPoint* also brought a drop in mean levels of evinced confidence, from 3.4 to 2.8. As noted, up to half the respondents in the 2nd survey may be different teachers, but the general trend indicates that anxiety levels were enhanced rather than assuaged during this pilot year. There are a number of possible explanations. One is that the wording of the question left it unclear whether the teachers were being asked if they were confident about teaching PowerPoint and Web authoring as IT skills, or just incorporating materials or student projects delivered via these media in their teaching. In the 1st survey there was some concern that IT-mediated teaching of English would not turn into teaching IT skills, and it is possible this remained a concern.

We then asked colleagues what benefits they perceived, personally and for the courses they coordinated or helped coordinate (all teachers are on at least one design team). The range of perceived benefits were predictable and similar to those nominated in the 1st, May 1998 survey, and were encouraging in their range and sophistication, given the relative novelty of IT in our practices. Perceived benefits for the courses were expressed largely in terms of curriculum-oriented benefits, but some addressed the possible impact on students. For a 2nd year, teachers nominated ease of access, range of choice, ease of communication, expansion of learning resources, individualization. In broader terms, many recognized the opportunity for professional development, keeping up to date, and projecting the right "progressive" image within the institution.

But it is at the level of perceived problems that the data become very interesting. In both surveys the teachers showed a sophisticated awareness of some of the fundamental problems with IT integration. This emerged on the issue of the threat of IT replacing teachers - via the administrator's imperative to save money via another form of automation – and on that of workload, as the e-mail response and online marking proposals have clear implications for teachers' time. After the pilot year skepticism remained high. A number of teachers used metaphors which suggested IT might be going through a transitory popularity phase. Teachers spoke of a "*fad*", "*keeping up with the Joneses*", a "*gimmick*", and a "*bandwagon*".

In May 1998, there had been a widespread expression of apprehension, amounting to outright fear and phobia in some cases. One teacher felt "uncertainty what to do when things go wrong & presenting myself as a "knower" & skilled user of the technology when I'm very much a learner; the capacity for demonstrating incompetence". One year later, this tended to be replaced with either a greater comfort with the type of support they had come to enjoy or a skepticism that IT integration was really a positive new direction for language pedagogy. A number of interesting points were raised, and the following table picks out a representative range of positive and negative comments from the 2nd May 1999 survey.

Positive	Negative
New skills: "Learning a new and transferable skill"	*Time*: "very time-consuming"; "time it takes to master IT programs and training"
Reliance: "I have learnt that I don't need to be a computer whiz myself – there are plenty of them around to help me"	*Apprehension*: Fear of computers taking over my teaching job"
Project: "The WebRighters' help is crucial – I don't think I could have worked on the course webs with the same level of	*Redundancy*: "If students know all the material is on the Web, they tend to feel they don't have to show up in class" *Fashion*: "a gimmick we hide behind, hoping it'll

confidence if they had not been there to help with the technical side of the materials production"	solve our problems" *De-skilling*: "It potentially deskills some very fine classroom teachers …not suited to this yet unproven bandwagon. *Infrastructure*: "Not enough ready-equipped classrooms; not many classrooms have sufficient facilities for us to conduct a lesson with IT"

A few of the respondents were clearly skeptical, questioning the assumed logic of an increasing integration of IT in our curricula. One respondent ascribed a "*Talebanistic zeal*" to the more engaged proponents of IT integration, and appealed to them to "*engage us poor apostates in a lively critical dialogue*", but then asked that this "*address issues such as how IT fits in with profoundly held beliefs*". Another respondent pointed to a "*Them/us divide between computer literates/illiterates*" and the danger of a belief in IT as a panacea. Mostly, however, the kinds of problems identified were those that might obstruct the optimal application of web-based technology.

Discussion

The aim of these 2 questionnaire surveys has been to form a profile of teachers' experiences, attitudes and values in relation to thisd IT integration initiative. Our intention is to use the resulting information to inform future IT integration policy in ways which take account of colleagues' states of mind and concerns.

As we have noted, the problems identified tended to be framed as constraints on the potential benefits – e.g. "*We need ready-equipped classrooms. It is horrendous having to carry/wheel around/set up IT equipment*". Only a few expressed misgivings about the potential of IT-mediated curricula. One respondent, aware of the return rate I was expecting, suggested the 50% non-respondents were likely to include those "*not that taken with the idea of integrating IT into the curricula*". Whether this is related to actual commitment shown, or general attitude, is hard to say, but this was the only case of a respondent expressing a negative construction of colleagues' attitudes to IT. Teachers were, however, concerned about how much would be expected of them as individual teachers with varying levels of computer literacy. There remained a degree of apprehension among our teachers, but one year later this took the form more of practical implications of excessive or unrealistic expectations regarding the authoring of Web materials, rather than the general anticipatory fear of the unknown expressed a year ago. Some respondents saw IT as a function that could be left to their less technologically-challenged colleagues. Most, though, tended to welcome the opportunity to be trained in the new technology, but expressed concern that too much would be expected of them. Fearing that our development funding would run out before the websites had reached fruition, one respondent asked if it was "*possible to organize a second WebRight project*".

Conclusion and Recommendations

These surveys taken together offer encouraging evidence of a positive, if occasionally apprehensive, response to the prospect of having to integrate IT into our teaching practices. They have also revealed a sophisticated understanding of the issues and of the potential of IT in enhancing the learning environment we could provide for our students. Colleagues identified a number of problems with the pace of change, and with the lack of support for many aspects of that change, and these confirmed ideas we had already been considering. We can offer the following advice to organisations considering moving to computer-mediated practice:

From a technological viewpoint, advice to anyone attempting this scale of IT integration into their curricula would be to explore the technology before planning your budget, and to plan for the time and resources required to be able to adapt to changes in technology.

From a staff management and development viewpoint, we would make the following recommendations:

1. Involve teachers in planning this kind of integration project;
2. Find out what they want/need/fear, etc.;
3. Make the CALL/CMC agenda *supportive* of existing practices;
4. Provide a steady program of incrementally-staged workshops;
5. Provide continuous "pastoral" support; ensuring you have budgeted for this support;
6. Wherever possible, pursue funding options for training and development; we found undergraduates perfectly able to handle Web authoring projects.

References

Bruce, N. (1999). *"Integrating computers into teaching practices: the value of a broad-based approach". Paper given at the* WorldCALL: CALL to Creativity Conference, Melbourne, July 13-17, 1998. In Eds J. Gassin et al: *Proceedings of the 1998 WorldCALL Conference*, pp. 153-154, ISBN 0 7340 1556 9. 1998 (PDF Document).
Fuller version available at http://ec.hku.hk/njbruce/OACESSurvey.htm

Bruce, N. & Desloge, P. (1997). Shifting sands: implications of integrating computer technologies into language curricula. Paper given at the International Language in Education conference, at the University of Hong Kong, Dec. 15-17.

Bruce, N. & Desloge, P. (1998). Virtual uncertainties: tolerating change in the planning of multimedia integration in language curricula. Paper given at Thai TESOL at Songkla, Thailand, Jan. 22-24.

Deming, M. P. (1987). The effects of word processing on basic college writers' revision strategies, writing apprehension, and writing quality while composing in the expository mode. PhD Thesis, Georgia State University [Ann Arbor, Mich. : University Microfilms International, 1988].

Higgins, J. (1988). *Language, learners and computers.* London: Longman.

Hiltz, S. R. (1994). *The virtual classroom: learning without limits via computer networks.* Norwood, NJ: Ablex.

Star, S.L. (Ed) (1995). *Ecologies of knowledge : work and politics in science and technology.* Albany : State University of New York Press.

Selfe, C.L. & S. Hillgoss (Eds) (1994). *Literacy and computers : the complications of teaching and learning with technology.* New York : Modern Language Association of America, 1994.

Warschauer, M. (1995). *E-mail for English teaching : bringing the Internet and computer learning networks into the language classroom.* Alexandria, Va.: Teachers of English to Speakers of Other Language, Inc.

Warschauer, M. (Ed) (1995). *Virtual connections : online activities & projects for networking language learners.* Honolulu, Hawaii : Second Language Teaching & Curriculum Center, University of Hawaii at Manoa.

Web-based Testing for Distance Education

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Abstract: The paper provides a technology-based review of Web-based testing technologies. It suggests an evaluation framework, which could be used by practitioners in Web-based education to understand and compare features available in various Web-based testing systems.

1. Introduction

Objective tests and quizzes are among the most widely used and well-developed tools in higher education. A classic test is a sequence of reasonably simple questions. Each question assumes a simple answer that could be formally checked and evaluated as correct, incorrect, or partly correct (for example, incomplete). Questions are usually classified into types by the type of expected answer. Classic types of questions includes yes/no questions, multiple-choice/single-answer (MC/SA) questions, multiple-choice/multiple-answer (MC/MA) questions, and fill-in questions with a string or numeric answer. More advanced types of questions include matching-pairs questions, ordering-questions, pointing-questions (the answer is one or several areas on a figure) and graphing-questions (the answer is a simple graph). Also, each subject area may have some specific types of questions.

Testing and quiz components were the first to be implemented and currently are the most well developed interactive components in Web-based education (WBE). Existing WBE systems differ in many aspects of dealing with tests and quizzes. When selecting a state-of-the-art technology for developing and delivering Web-based quizzes at Carnegie Technology Education we have created a multi-facet framework for comparing available systems. This paper provides a comprehensive review of features, which are important to evaluate current technologies for Web-based testing. Our framework could be used by practitioners in Web-based education to understand and compare features available in various Web-based testing systems.

2. Life cycle and anatomy of questions

To compare existing options we have analyzed the life cycle of a question in Web-based education (see Table 1). We divided the life cycle of a question into three stages: preparation (before active life), delivery (active life), and assessment (after active life). Each of these stages is further divided into smaller stages. For each of these stages we have investigated a set of possible support technologies.

Life of a question begins at *authoring* time. The role of WBE systems at the authoring stage is to support the author by providing a technology and a tool for question authoring. All authored questions (the content and the metadata) are *stored* in the system. The active life of a stored question starts when it is *selected for presentation* as a part of a test or quiz. This selection could be done statically by a teacher at course development time, or dynamically by a system at run time (by probability or according to some cognitive model).

Next, the system *delivers* a question: it presents the question, it provides an interface for the student to answer; it gets the answer for evaluation. At the *assessment* stage, the system should do the following things: evaluate the answer as correct, incorrect, or partly correct, deliver feedback to student, grade the question and to record student performance.

Existing WBE tools and systems differ significantly on the type and amount of support they provide on each of the stages mentioned above. Simple systems usually provide partial support for a subset of the stages. The cutting-edge systems provide comprehensive support at all the listed stages. The power of a system and the extent of provided support is seriously influenced by the level of technology used at each of the main stages - preparation, delivery and assessment. Below we will analyze the currently explored options.

Before	During	After
Preparation: • Author • Store • Select	Delivery: • Present • Interact • Get the answer	Assessment: • Evaluate • Grade and record • Deliver feedback

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Table 1. Life cycle stages of a test question.

3. Preparation stage

Questions are created by a human authors - teachers and content developers. A state-of-the-art question has the following components: the question itself (or *stem*), a set of possible answers, an indication which answers are correct, a type of the interface for presentation, question-level feedback that is presented to the student regardless of the answer, and specific feedback for each of the possible answers. In addition, an author may provide metadata such as topics assessed, keywords, the part of the course a test belongs to, question weight or complexity, allowed time, number of attempts, ,etc. This metadata could be used to select a particular question for presentation as well as for grading the answer.

The options for *authoring support* usually depends from the technology used for storing an individual question in the system. Currently, we could distinguish two different ways to store a question: *presentation format* and *internal format*. In WBE context, storing a question in presentation format means storing it as a piece of HTML code (usually, as an HTML form). Such questions could be also called static questions. They are "black boxes" for a WBE system: It can only present static questions "as is". The authoring of this type of questions is often not supported by a WBE system. It could be done in any of HTML authoring tools.

Storing a question in an internal format usually means storing it in a database record where different parts of the question (stem, answers, and feedback) are stored in various fields of this record. A question as seen by a student is generated from the internal format at the delivery time. Internal format opens the way for more flexibility: the same question could be presented in different forms (for example, fill-in or multiple choice) or with different interface features (for example, radio buttons or selection list). Options in multiple choice questions could be shuffled [Carbone & Schendzielorz 1997]. It provides a higher level of individualization. This is pedagogically useful and decreases the possibility of cheating. There are two major ways for authoring questions in internal format: a form-based *graphical user interface* (GUI) or a special *question marckup language* [Brown 1997; Campos Pimentel, dos Santos Junior & de Mattos Fortes 1998; Hubler & Assad 1995]. Each of these approaches has its benefits and drawbacks. Currently, a GUI approach is much more popular. It is used by all advanced commercial WBE systems such as [Blackboard 1998; Question Mark 1998; WBT Systems 1999; WebCT 1999]. Note, however, that some WBE systems use GUI authoring approach but do not store questions in internal format. Instead, these systems generate HTML questions" right away" and store them as static questions

The simplest option for *question storage* is *a static test or quiz*, i.e., a static sequence of questions. The quiz itself is usually represented in plain HTML form and authored with HTML-level authoring tools. Static tests and quizzes are usually "hardwired" into some particular place in a course. One problem with this simplest technology is that all students get the same questions at the same point in the course. Another problem is that each question hardwired into a test is not reusable. A better option for question storage is a *hand-maintained pool of questions*. The pool could be developed and maintained by a group of teachers of the same subject. Each question in a question pool is usually static, but the quizzes are more flexible. Simple pool management tools let the teacher re-use questions; all quizzes may be assembled and added to the course pages when it is required. This is what we call *authoring time flexibility*. The same course next year, a different version of the course, or sometimes even different groups within the same course may get different quizzes without the need to develop these quizzes from scratch.

An even better option is to turn a hand-maintained pool into a database of questions. A database adds what we call *delivery time flexibility*. Unlike a hand-maintained pool, a database is formally structured and is accessible by the delivery system. With a database of questions not only the teacher can assemble a "quiz-on-demand", the system itself can generate a quiz from a set of questions. Naturally, the questions could be randomly selected and placed into a quiz in a random order [Asymetrix 1998; Brown 1997; Byrnes, Debreceny & Gilmour 1995; Carbone & Schendzielorz 1997; Ni, Zhang & Cooley 1997; Radhakrishnan & Bailey 1997; WBT Systems 1999; WebCT 1999]. As a result, all students may get personalized quizzes (a thing that a teacher can not realistically provide manually) significantly decreasing the possibility of cheating. Note that implementation of a database of questions does not require the use of a commercial database management system. Advanced university systems like QuestWriter [Bogley et al. 1996] or Carnegie Mellon Online [Rehak 1997] and many commercial systems such as TopClass [WBT Systems 1999] or LearningSpace [Lotus 1999] use full-fledge databases such as ORACLE or Lotus Notes for storing their pools of question in internal format. However, there are systems which successfully imitate a database with the UNIX file system using specially structured directories and files [Byrnes, Debreceny & Gilmour 1995; Gorp & Boysen 1996; Merat & Chung 1997].

A problem for all systems with computer-generated quizzes is how to ensure that these quizzes include a proper set of questions. The simplest way to achieve it is to organize a dedicated question database for each lesson. This approach, which is, for example, used in WebAssessor [ComputerPREP 1998], reduce question reusability between lessons. More advances systems like TopClass [WBT Systems 1999] can maintain multiple pools of and can use several pools for generating each quiz. With this level of support a teacher can organize a pool for each topic or each level of question complexity and specify the desired number of questions in a generated quiz to be taken from each pool.

A database of questions in internal format is currently a state-of-the art storage technology. Research teams are trying to advance it in three main directions. One direction is related to *parameterized questions* as in CAPA [Kashy et al. 1997], EEAP282 [Merat & Chung 1997], or Mallard [Brown 1997; Graham, Swafford & Brown 1997]. This allows one to create an unlimited number of tests from the same set of questions and can practically eliminate cheating [Kashy et al. 1997]. The second direction of research is related to question metadata. If the system knows a little bit more *about* the question (for example, type, topics assessed, keywords, part of the course a test belongs to, weight or complexity) then the system can generate customized and individualized quizzes by author's or system's request. This means that the authors could specify various parameters for the quiz their student needs at some point of the course: total number of questions, proportion of questions of specific types or for specific topics, difficulty, etc., and the system will generate a customized quiz on demand (that is still randomized within the requirements) [Byrnes, Debreceny & Gilmour 1995; Merat & Chung 1997; Rehak 1997; Rios, Pérez de la Cruz & Conejo 1998]. This option is definitely more powerful than simple randomized quizzes. Systems that make extensive use of metadata really "know" about the questions and their functionality. The third direction of research is the adaptive sequencing of questions. This functionality is based on an overlay student model which separately represents student knowledge of different concepts and the topics of the course. Intelligent systems such as ELM-ART [Weber & Specht 1997], Medtec [Eliot, Neiman & Lamar 1997], [Lee & Wang 1997], SIETTE [Rios, Pérez de la Cruz & Conejo 1998], Self-Learning Guide [Desmarais 1998] can generate challenging questions and tests adapted to the student level of knowledge as well as reduce the number of questions required to assess the students state of knowledge.

4. Delivery stage

The interaction technology used to get an answer from the student is one of the most important parameters of a WBE system. It determines all delivery options and influences authoring and evaluation. Currently, we distinguish five technologies: HTML links, HTML/CGI forms, scripting language, plug-in, and Java.

HTML links is a simple interaction technology that presents a set of possible answers as list of HTLM links. Each link is connected to a particular feedback page. The problems here are that questions are hard to author (because question logic must be hardwired into course hypertext) and that it supports only yes/no and MC/SA questions. This technology was in use in the early days of WBE when more advanced interaction technologies like Common Gateway Interface (CGI), JavaScript or Java were not established [Holtz 1995].

The most well-established technology for Web testing which is used now in numerous commercial and university-grown systems is a combination of HTML forms and CGI-compliant evaluation scripts. HTML forms are very well suited for presenting main types of questions. Yes/no and MC/SA questions are represented by radio buttons, selection lists, pop-up menus, MC/MA questions are represented by multiple selection lists or checkboxes. Fill-in questions are implemented with input fields. More advanced questions such as matching pairs or ordering can also be implemented using forms. In addition, hidden fields can be successfully used to hold additional information about the test which a CGI script may need. There are multiple benefits of using server-side technology such as form/CGI technology and a similar server-side map technology that can be used for implementing graphical pointing questions. Test development is relatively simple and can even be done with HTML authoring tools. Sensitive information which is required for test evaluation (such as question parameters, answers, feedback) may be safely stored on the client side preventing students from stealing the question (the only external information which is required in a well-developed system to evaluate a test is the test ID and the student ID). Server-side evaluation makes all assessment time functions (such as recording results, grading, providing feedback) easy to implement. All these functions could be performed by the same server-side evaluation script. The main problem of server-side technology is its low expressive power. It is well suited only for presenting basic types of tests. More advanced types of tests as well as more interactive types of tests (for example, tests which involve drag-and-drop activities) can not be implemented with pure sever-side technology. Authoring questions with server-side evaluation is tricky because a question's functionality is spread between its HTML presentation (either manually authored or generated) and a CGI evaluation script. Another serious problem is CGI-based questions do not work when a user's connection to the server is broken or very slow.

A newer technology for question delivery and evaluation is JavaScript [McKeever, McKeever & Elder 1997]. The interface provided by the JavaScript interaction technology is similar to the one of form/CGI technology. At the same time, JavaScript functionality supports more advanced, interactive questions, for example, selection of a relevant fragment in a text. With pure JavaScript technology all data for question evaluation and feedback as well as evaluation program should be stored as a part of the question text. It means that a JavaScript question can work in standalone mode. It means that the question is self-sufficient: everything for presentation and evaluation is in the same file, and is a very attractive option for authoring. But it also means that students can access the source of the question and crack it. Also, with pure JavaScript evaluation technology there is no way for recording the results and grades. With all the above features JavaScript technology is a better choice for self-assessment tests than for assessments used in grading. We think the proper place for JavaScript in WBE is in a hybrid JavaScript/server technology. With this technology JavaScript can be used to present more types of questions, do it more interactively and with compelling user interfaces leaving evaluation and recording to be done by traditional CGI for reasons of security [ComputerPREP 1998; WebCT 1999].

A higher level of interface freedom can be achieved by using a plug-in technology.[1] The only example of serious use of this technology in education is the Shockwave plug-in [Macromedia 1998] which can run multimedia presentations prepared with several Macromedia authoring tools. Currently, Shockwave technology is used in WBE mainly for delivering "watch-only" animations, but this technology is more powerful. In fact, a variety of very attractive Shockwave-deliverable questions could be developed using Macromedia tools with relatively low effort. Some examples could be provided by Medtec [Eliot, Neiman & Lamar 1997]. The negative side is the same as with JavaScript: recording assessment results requires connection to the server. Until recently, Shockwave provided no Internet functionality and its users had to apply special techniques (e.g. saving evaluation results in a temporal file). Due to Shockwave communication problems, some teams that started with Shockwave migrated later to more powerful Java technology [Eliot, Neiman & Lamar 1997]. Still Shockwave still stands as a solid (and overlooked) platform for delivering various self-assessment questions.

The highest level technology for question delivery is provided by Java. An important advantage of Java is that it is a complete programming language designed to be integrated with browser functionality and the Internet. Java combines connectivity of form/CGI technology and the interactivity of Shockwave and JavaScript. Any question interface can be developed with Java, and, at the same time, Java-made questions can naturally communicate with the browser as well as with any Internet object (a server or a Java application). Examples of systems which heavily use Java-based questions are FLAX [Routen, Graves & Ryan 1997], NetTest [Ni, Zhang & Cooley 1997], Mallard [Graham & Trick 1997], and Medtec [Eliot, Neiman & Lamar 1997]. Developing question interfaces with Java is more complicated than with form/CGI technology and it is not surprising that all the examples mentioned above were produced by advanced teams of computer science professionals. However, the complexity will not stop this technology. Java is currently the way to implement a variety of question types non-implementable with form/CGI technology such as multiple pointing questions, graphing questions, and specialized types of questions. Developing Java-based questions can become suitable for ordinary authors with the appearance of Java based authoring systems [Ni, Zhang & Cooley 1997; Routen, Graves & Ryan 1997].

5. Assessment stage

As we noted, the choice of interaction technology significantly influences *evaluation* options. Evaluation is the time when an answer is judged as correct, incorrect, or partially correct (for example, incomplete). Usually, correct and incorrect answers are provided at authoring time, so evaluation is either hardwired into the question like in MC/SA questions, or performed by simple comparison (in fill-in questions). There are very few cases that require more advanced evaluation technology. In some domains correct answers may not be literally equal to a stored correct answer. Examples are a set of unordered words, a real number, a simple algebraic expression [Holtz 1995; Hubler & Assad 1995]. In this situation a simple comparison program is required. Some systems may apply special intelligent technologies for matching answers [Hubler & Assad 1995]. Finally, in some cases a "domain expert" such as the Lisp interpreter for Lisp programming as in the ELM-ART system [Brusilovsky, Schwarz & Weber 1996] or a computer algebra system for algebra domain [Pohjolainen, Multisilta & Antchev 1997] is required to evaluate the answer. The first two evaluation options are very simple and could be implemented with any interface technology - even JavaScript could be used to write a simple comparison program. If more advanced computation is required (as in the case of intelligent answer matching) the choice is limited to full-function programming with either Java or a server side program using a CGI interface. If a "domain expert" is required for evaluation, the only option currently is to run a domain expert on the server side with a CGI-compliant gateway. In fact, a number of "domain expert" systems (for example, Mathematica computer algebra system) have a CGI gateway.

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[1] Plug-in technology enables independent vendors to extend the browser functionality by developing specially structured programs called *plug-ins*. At start-up time, a browser loads all plug-ins located in a special directory and they become parts of the browser code.

The usual options for the *feedback* include: simply telling if the answer is correct, not, or partially correct, giving correct answer, and providing some individual feedback. Individual feedback may communicate: what is right in the correct answer, what is bad in incorrect and partially incorrect answer, provide some motivational feedback, and provide information or links for remediation. All individual feedback is usually authored and stored with the question. A system that includes assessed concepts or topics as a part of question metadata can provide good remedial feedback without direct authoring since it "knows" what knowledge is missing and where it can be found. It means that the power of feedback is determined by authoring and storage technology. The amount of information presented as feedback is determined by the context. In self-assessment the student usually receives all possible feedback - the more the better. This feedback is a very important source of learning. In a strict assessment situation the student usually gets neither a correct answer, nor whether the answer is correct. The only feedback for the whole test might be the number of correctly answered questions in a test [Rehak 1997]. This greatly reduces the student's chances for cheating and student's chances to learn. To support learning, many existing WBE systems make assessment less strict and provide more feedback trying to fight cheating by other means. The only way to combine learning and strict assessment is to use more advanced technologies such as parameterized questions [Brown 1997; Hubler & Assad 1995; Kashy et al. 1997; Merat & Chung 1997] and knowledge based test generation [Eliot, Neiman & Lamar 1997; Weber & Specht 1997] which can generate an unlimited number of questions. In this situation a WBE system can provide full feedback without promoting cheating.

If a test is performed purely for self-assessment then generating feedback could be the last duty of a WBE system in the "after-testing" stage. The student is the only one who needs so see test results. In the assessment context the last duty of a WBE system in the process of testing is to *grade student performance on a test and to record these data* for future use. Grades and other test results are important for teachers, course administrators, and students themselves (a number of authors noted that the ability to see their grades online is the most student-appreciated feature of a WBE system). Early WBE systems provided very limited support for a teacher in test evaluation. Results were either sent to the teacher by e-mail or logged into a special file. In both cases a teacher was expected to complete grading and recording personally: to process test results and grade them, to record the grades, and to ensure that all involved parties get access to data according university policy. This option is easy to implement and it does not require that teachers learn any new technology. For the latter reason this technology is still used as an option in some more advanced systems [Carbone & Schendzielorz 1997]. However, a system that provides no other options for grading and recording is now below a state-of-the-art. A state-of-the-art WBE system should be able to grade a test automatically, recording test results in a database. It also should provide properly restricted access to the grades for students, teachers, and administrators. Restrictions are usually determined by university policies. For example, a student may not be allowed to see grades of other students or a teacher could be allowed to change the automatically assigned grades. Many university-level systems [Bogley et al. 1996; Brown 1997; Carbone & Schendzielorz 1997; Gorp & Boysen 1996; Hubler & Assad 1995; MacDougall 1997; Ni, Zhang & Cooley 1997; Rehak 1997] and almost all commercial level systems [Lotus 1999; WBT Systems 1999; WebCT 1999]provide this option in a more or less advanced way. Less advanced systems usually store the grades in structured files and provide limited viewing options. Advanced systems use database technology to store the grades and provide multiple options for viewing the grades and other test performance results such as time on a test or a number of efforts made. Database technology makes it easy to generate various test statistics involving results of many students on many course tests. In a Web classroom, where student-to-student and student-to-teacher communication is limited, comparing statistics is very important for both - teachers and students to get the "feeling" of the classroom. For example, by comparing class average with personal grades a student can determine class rank. By comparing class grades for different tests and questions a teacher can find too simple, too difficult, and even incorrectly authored questions.

References

[Asymetrix 1998] Asymetrix (1998). Librarian, Asymetrix Learning Systems, Inc., Bellevue, WA. http://www.ASYMETRIX.com/products/librarian/ (Accessed 20 September, 1998)

[Blackboard 1998] Blackboard (1998). CourseInfo 1.5, Blackboard Inc. http://www.blackboard.net/ps_courseinfo.htm (Accessed 21 August, 1998)

[Bogley et al. 1996] Bogley, W.A. et al. (1996). New pedagogies and tools for Web based calculus. WebNet'96, World Conference of the Web Society, AACE. 33-39.

[Brown 1997] Brown, D.J. (1997). Writing Web-based questions with Mallard. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 1502.

[Brusilovsky, Schwarz & Weber 1996] Brusilovsky, P., Schwarz, E., & Weber, G. (1996). ELM-ART: An intelligent tutoring system on World Wide Web. In Frasson, C., Gauthier, G., & Lesgold, A. (Ed.), Intelligent Tutoring Systems (Lecture Notes in Computer Science, Vol. 1086). Berlin: Springer Verlag. 261-269.

[Byrnes, Debreceny & Gilmour 1995] Byrnes, R., Debreceny, R., & Gilmour, P. (1995). The Development of a Multiple-Choice and True-False Testing Environment on the Web. Ausweb95: The First Australian World-Wide Web Conference, Southern Cross University Press. http://elmo.scu.edu.au/sponsored/ausweb/ausweb95/papers/education3/byrnes/

[Campos Pimentel, dos Santos Junior & de Mattos Fortes 1998] Campos Pimentel, M.d.G., dos Santos Junior, J.B., & de Mattos Fortes, R.P. (1998). Tools for authoring and presenting structured teaching material in the WWW. WebNet'98, World Conference of the WWW, Internet, and Intranet, AACE. 194-199.

[Carbone & Schendzielorz 1997] Carbone, A., & Schendzielorz, P. (1997). Developing and integrating a Web-based quiz generator into the curriculum. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 90-95.

[ComputerPREP 1998] ComputerPREP (1998). WebAssessor, ComputerPREP, Inc, Phoenix, AZ. http://www.webassessor.com (Accessed 23 May, 1998)

[Desmarais 1998] Desmarais, M.C. (1998). Self-Learning Guide Stuttgart, Germany, CRIM, Montreal. http://www.crim.ca/hci/demof/gaa/introduction.html (Accessed July 5, 1999)

[Eliot, Neiman & Lamar 1997] Eliot, C., Neiman, D., & Lamar, M. (1997). Medtec: A Web-based intelligent tutor for basic anatomy. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 161-165. ,

[Gorp & Boysen 1996] Gorp, M.J.V., & Boysen, P. (1996). ClassNet: Managing the virtual classroom. WebNet'96, World Conference of the Web Society, AACE. 457-461.

[Graham, Swafford & Brown 1997] Graham, C.R., Swafford, M.L., & Brown, D.J. (1997). Mallard: A Java Enhanced Learning Environment. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 634-636.

[Graham & Trick 1997] Graham, C.R., & Trick, T.N. (1997). An innovative approach to asynchronous learning using Mallard: Application of Java applets in a freshman course. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 238-244.

[Holtz 1995] Holtz, N.M. (1995). The Tutorial Gateway, Carleton University, Ottawa, CA. http://www.civeng.carleton.ca/~nholtz/tut/doc/doc.html (Accessed 1995)

[Hubler & Assad 1995] Hubler, A.W., & Assad, A.M. (1995). CyberProf: An Intelligent Human-Computer Interface for Asynchronous Wide Area Training and Breakching. 4th International World Wide Web Conference. http://www.w3.org/pub/Conferences/WWW4/Papers/247/

[Kashy et al. 1997] Kashy, E. et al. (1997). Using networked tools to enhanse student success rates in large classes. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 233-237.

[Lee & Wang 1997] Lee, S.H., & Wang, C.J. (1997). Intelligent hypermedia learning system on the distributed environment. ED-MEDIA/ED-TELECOM'97 - World Conference on Educational Multimedia/Hypermedia and World Conference on Educational Telecommunications, AACE. 625-630.

[Lotus 1999] Lotus (1999). LearningSpace 2.0, Lotus, Cambridge, MA. http://www.lotus.com/products/learningspace.nsf (Accessed 5 June, 1999)

[MacDougall 1997] MacDougall, G. (1997). The Acadia advantage adademic development centre and the authomatic courseware management systems. ED-MEDIA/ED-TELECOM'97 - World Conference on Educational Multimedia/Hypermedia and World Conference on Educational Telecommunications, AACE. 647-652.

[Macromedia 1998] Macromedia (1998). Shockwave, AACE. http://www.macromedia.com/shockwave/ (Accessed September 12, 1998)

[McKeever, McKeever & Elder 1997] McKeever, S., McKeever, D., & Elder, J. (1997). An authoring tool for constructing interactive exercises. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 695-696.

[Merat & Chung 1997] Merat, F.L., & Chung, D. (1997). World Wide Web approach to teaching microprocessors. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 838-841.

[Ni, Zhang & Cooley 1997] Ni, Y., Zhang, J., & Cooley, D.H. (1997). NetTest: An integrated Web-based test tool. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 71[illegible]- [illegible]11.

[Pohjolainen, Multisilta & Antchev 1997] Pohjolainen, S., Multisilta, J., & Antchev, K. (1997). Matrix algebra with hypermedia. Education and Information Technologies, 1 (2), 123-141.

[Question Mark 1998] Question Mark (1998). Perception, Question Mark Corporation, Stamford, CT. http://www.questionmark.com/ (Accessed September 30, 1998)

[Radhakrishnan & Bailey 1997] Radhakrishnan, S., & Bailey, J.E. (1997). Web-based educational media: Issues and empirical test of learning. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 400-405.

[Rehak 1997] Rehak, D. (1997). A database architecture for Web-based distance education. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 418-425.

[Rios, Pérez de la Cruz & Conejo 1998] Rios, A., Pérez de la Cruz, J.L., & Conejo, R. (1998). SIETTE: Intelligent evaluation system using tests for TeleEducation. Workshop "WWW-Based Tutoring" at 4th International Conference on Intelligent Tutoring Systems (ITS'98). http://www-aml.cs.umass.edu/~stern/webits/itsworkshop/rios.html

[Routen, Graves & Ryan 1997] Routen, T.W., Graves, A., & Ryan, S.A. (1997). Flax: Provision of interactive courseware on the Web. Cognition and the Web '97. 149-157. http://www.cms.dmu.ac.uk/coursebook/flax/

[WBT Systems 1999] WBT Systems (1999). TopClass 3.0, WBT Systems, Dublin, Ireland. http://www.wbtsystems.com/ (Accessed 5 July, 1999)

[WebCT 1999] WebCT (1999). World Wide Web Course Tools 1.3.1, WebCT Educational Technologies, Vancouver, Canada. http://www.webct.com (Accessed 15 February, 1999)

[Weber & Specht 1997] Weber, G., & Specht, M. (1997). User modeling and adaptive navigation support in WWW-based tutoring systems. In Jameson, A., Paris, C., & Tasso, C. (Ed.), User Modeling . Wien: Springer-Verlag. 289-300.

Interactive Multimedia Learning Environments: Tools to Foster Transition to the Learning Paradigm.

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Abstract
Higher education has begun transitioning from a traditional emphasis on the delivery of content (the Instructional Paradigm) to the more demanding goal of creating powerful learning environments that meet the needs of a diverse student community (the Learning Paradigm). However, most higher education faculty have been trained as researchers, not educators in the sense of the Learning Paradigm. We have used the development of interactive multimedia learning environments as a device to allow faculty to explore principles of the Learning Paradigm. In this regard, three pedagogical features of the technology resonated with many faculty and are identified below. In addition, we illustrate a simple taxonomy of four kinds of learning environments that our faculty have developed, ranging from highly structured environments to open-ended research simulations. Lastly, we explore assessment issues as they vary across this learning continuum.

Higher education has entered a transition from the Teaching Paradigm to the Learning Paradigm. This transition results from a variety of pressures that have created a climate of pedagogical self-examination during this "Decade of the Brain." Emerging from this process are powerful new teaching styles founded on principles of active-learning and improved insights on the cognitive development of learning. In science education, where this change has been late in arriving, the educational community has embraced the principle that we must provide high quality learning experiences for all students regardless of their learning styles. However, recognizing the need for change is simpler than achieving systematic change.

At the same time, educational technology is looming as a preeminent force in higher education. Of special interest to us are learning environments that exploit interactive multimedia. The educational potential of this technology closely parallels the pedagogical goals of the Learning Paradigm. However, the adoption of these powerful tools has not advanced as rapidly as its advocates have predicted. In part, this is because the pedagogical potential of the technology is subtle to faculty untrained to exploit it. Probably the learning potential of the technology is often constrained by its mismatch with current practice. Faculty who operate within the confines of the traditional Instructional Paradigm are less likely to perceive and exploit the full learning potential of the technology. Also, the tremendous variety of learning environments seems to confuse many faculty. The pedagogical feature set of the technology is often not readily apparent and faculty frequently use the technology to "make a better lecture".

We would like to suggest a simple pedagogical feature set that resonates with many faculty and that can foster transition to the Learning Paradigm.

1. Interactivity fosters active learning,
2. The sensory-rich nature of this technology facilitates the engagement of additional powerful cognitive processes, and
3. Integration of assessment tools into the environment can provide students with feedback and encouragement, allow the collection of diagnostic clues about individual student learning needs, and enable the collection data to evaluate student learning outcomes.

We have used this tool in our own institution with such success that one half of the faculty have requested training in interactive multimedia authoring and one quarter of the faculty (74) have already undergone initial training. Subsequent surveys of faculty attitudes and technology use patterns indicate that faculty trained with an interactive multimedia authoring experience became much more optimistic about the ability of educational technology to improve student motivation and ability to learn. Although it may not be surprising that these faculty utilized interactive multimedia more in their teaching, they also used a much greater variety of educational technology with greater intensity after having had an authoring experience.

We will present examples of four kinds of learning environments developed in the Department of Biology of the University of Hartford to illustrate these principles:

1. Learning facts: "Cell Differentials". This system simulates a clinical experience in which students must classify 100 white blood cells and suggest what pathology might be indicated by this profile. This environment includes three kinds of assessment tools. To provide incentive to strive for competency, a quiz system is integrated. This grading system keeps a running mean of the last three performances, which encourages recurrent trials when necessary. Second, the instructor can enable a feedback function that informs students of the correct answer when they misidentify a cell type. Third, to provide diagnostic clues about individual student needs, two additional kinds of assessment are provided. A graphical display shows at a glance a matrix of cell type scores in the rows, with actual identities in the columns. The results are automatically saved for faculty review in a player application later. At the end of any 100 cell "lesson", a replay button can be clicked to call up a random review of all mistakes, so that the instructor and student can work closely on items with which the student may be struggling (Figure 1).

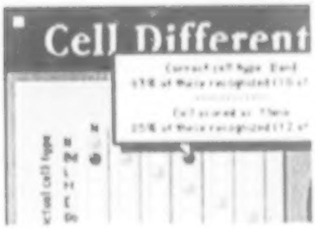

Figure 1. Practicing white blood cell identification before a wet lab.

This system is not intended to replace the wet lab. Rather it serves as a preface to even the playing field for people with different learning styles. In traditional wet labs, students examine real microscope slides in an individualistic environment (a microscope) that provides little feedback. Usually, only assertive students willing to call the instructor back again and again get substantial personal feedback.

2. Building concepts: "Eukaryotic Cell Divisions". The study of hierarchical systems, like those typical in biology, is often challenging to students because synthesis across levels of organization in a hierarchy is a demanding task. In this learning environment, content is chunked into short presentations followed immediately by assessment experiences that enable students to use the information incrementally as the content unfolds. Summary displays of student achievement are available for viewing and are automatically output to the instructor's server, as in the Cell Differentials system. Again, running means of the last three quiz grades encourage recurrent practice for those students who need it (Figure 2).

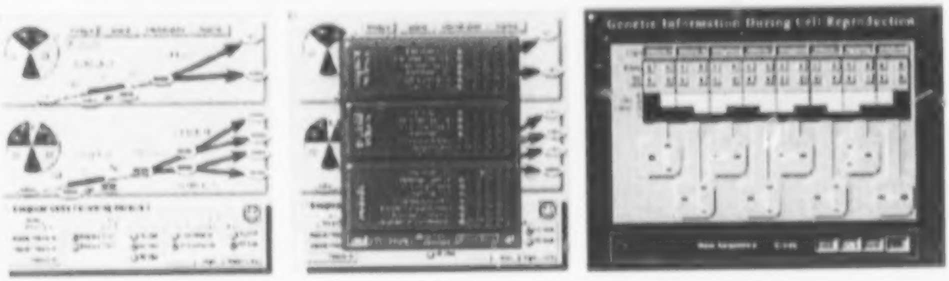

Figure 2. Exploring genetic changes in eukaryotic cell divisions to encourage students in concept-building. Assessment tools to collect diagnostic information about individual student learning needs.

This lesson was developed to give students practice in a demanding learning task. Early mean quiz grades have increased from the low 50s to the low 80s, with 90% of the students attaining a 90% proficiency within one week, compared to the mean 70% proficiency after two weeks with previous paper and pencil exercises. The effectiveness of this method has not only improved student learning outcomes dramatically, but it works so quickly that it has allowed the addition of additional course content, not the usual outcome of adopting more powerful pedagogies.

3. Experiencing Critical Inquiry: "The Search for the Hereditary Molecule". The previous two systems illustrate learning environments that are directed toward the mastery of foundational information.

Assessment tools can be developed with comparative ease for such structured learning goals. However, learning environments designed to foster the development of critical inquiry skills must be more open-ended. Students must be allowed to explore and to make mistakes more freely. Student interaction with the learning environment is of a higher order, but assessment is correspondingly more challenging.

In this research simulation, students are provided with the tools used in a famous experiment and also instructed what the basic research question was. The students are then invited to design a research program to resolve the question. We have taken two approaches to assessment. Limited structured assessment tools are provided to give students feedback about their understanding of foundational information necessary to design an insightful experiment. Assessment can assume a more reflective experience in active learning environments in which an effort is being made to transfer the authority of learning to the students. Therefore a different kind of assessment is employed to reinforce the learning experience of the more open-ended component of this system. The system actually includes several different sub-simulations that allow students to experience the inquiry in several different ways. Each of the three modules provides alternative insights about experimental design:

1. a virtual lab with emulated test tubes and petri dishes to manipulate,
2. a spreadsheet-like module that emphasizes an experimental design overview, and
3. a flow sheet in which the computer produces hypothetical realities that the student must interpret from experimental results (Figure 3).

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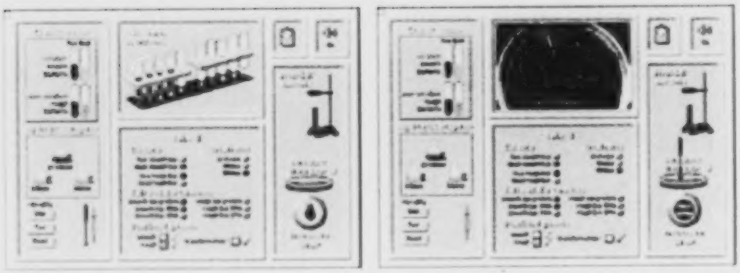

Figure 3. *The Search for the Hereditary Molecule:* A research simulation

4. Using interactive multimedia to foster student-originated research: "Developmental Selection". We have attempted to transition our introductory biology laboratory classes from traditional menus of demo-like experiences to real research experiences in which students are pursuing questions that they have originated. This is a challenging freshman experience. These young people usually lack the necessary foundational information required to originate questions. They usually have no previous research experience and can bring only superficial epistemological insights to bear in these inquiries.

   We have developed several research simulations that elevate the preparation of most of our freshman students to participate successfully in this demanding program. These environments will be illustrated with our "Developmental Selection" research simulation. It includes three major modules. The first component allows students to alter system parameters with sliders, which allows them to develop their understanding of the foundational information required to study this phenomenon. The two remaining parts of the system focus the students experience on the differences between the initial "data collection" phase of the research experience and the "data analysis" phase of the investigation. Students often confuse these two processes.

   Assessment in this open-ended learning experience assumes a new form. As students move from the simulation to experimental design with real field samples in mind, real life issues like sample sizes and subtleties of the data scoring of complicated phenomena come into focus. Rather than relying on faculty authority to answer these questions, students are encouraged to return to the simulations to probe specific issues themselves. They learn the value of models to test our assumptions and to evaluate complicated phenomena in relative painless ways.

   Before the development of these research simulations, only our best students excelled in this experience. Many of our students seemed lost and revealed only limited learning outcomes from the experience. Introduction of these simulation prefaces has again evened the playing field for students with different levels of preparation for the experience (Figure 4).

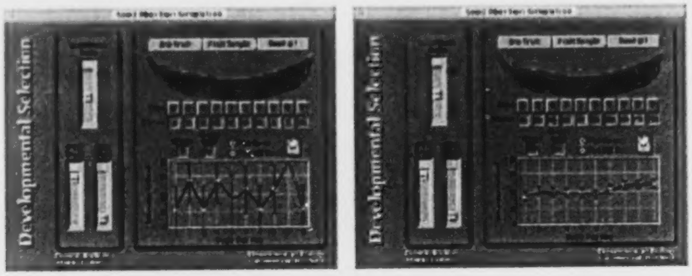

Figure 4. *Developmental Selection*: A simulation to foster student-originated research.

To summarize, the development of interactive multimedia learning environments by our faculty has allowed our faculty to teach things that we found difficult to teach before and we have been able to produce improved leaning outcomes for other content that was pedagogically challenging. Moreover, authoring interactive multimedia learning

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environments has allowed faculty to explore important principles of the learning paradigm that seemed much more daunting with traditional instructional methods. This technology has fostered the advancement of active-learning pedagogies in our teaching. It has improved our ability to exploit new insights about the cognitive development of learning. The utility of the computer to monitor student progress has encouraged us to think more carefully about assessment and to strive for the development of assessment tools that allow us to give our students more individual attention. Our authoring experiences have forced us to think more carefully about the appropriateness of different kinds of assessment tools for different kinds of learning experiences, especially new views of assessment that might better support open-ended learning experiences and active learning environments. Collectively, these features have allowed us to serve the varied learning styles of our students more carefully.

Citations

Barr, R, & J. Tagg. 1995. *From Teaching to Learning — A New Paradigm for Undergraduate Education.* Change 27 (6): 12-25.

Chickering , A., & S. Ehrmann. 1997. *Implementing the Seven Principles: Technology as Lever.* AAHE Bulletin. http://www.aahe.org/technology/ehrmann.htm.

Flagg., B. 1990. *Formative Evaluation for Educational Technologies.* LawrenceErlbaum Associates, Publishers. Hillsdale, NJ.

Melvin, D., S. Bragg, A. de los Santos, Jr., D. Denton, P. Gerber, M. Lindquist, J. Rosser, D. Snchez, & C. Meyers. 1997. *Shaping the Future - New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology.* National Science Foundation, Department of Undergraduate Education.

Merisotis, J., & R. Phipps. *What's the Difference? Outcomes of Distance vs. Traditional Classroom-based Learning.* Change 31: 12-17.

National Research Council, *From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology, a National Science Foundation/ National Research Council Convocation, April 9-11, 1995.*

Sandholtz, J.H., C. Ringstaff, & D.C. Dwyer. 1997. *Teaching with Technology – Creating Student-Centered Classrooms.* Teachers College, Columbia University Press, NY.

Using Technology to Manage Diverse Student Needs

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Abstract: A significant challenge facing educators today is how to accommodate students with different levels of preparedness. In many courses the gap between the most prepared and least prepared student is wide and growing. Our experience suggests that asynchronous online education can be part of the solution. In this paper we report on our experience teaching an introductory computer class over the Internet. We discuss how we are using Internet technologies to enhance the presentation of course material and information technologies to automate course management activities. Automating routine teaching and administrative activities has given us more time to work directly with students. This together with the asynchronous nature of the course has enabled us to successfully offer the course to an increasingly diverse student population.

1. Introduction

Three years ago it was becoming increasingly difficult to run our introductory computer class. In any one section it was not uncommon to have students with several years of computer experience sitting next to those who were just learning to use the mouse. Because it was an introductory computer class we couldn't assume any prior knowledge so instruction for everyone had to start at the beginning. Making matters worse, the opportunity for exposure to computers and the Internet was growing at an exponential rate so each semester the skill level of the best students kept getting better.

In response to this challenge (and for other reasons) we decided to put our introductory computer class online. More specifically we set out to:

1. Put all instruction and evaluation online in an asynchronous format. Students could work at their own pace and skip lessons on topics they already knew.
2. Use multiple media types and rich media types to accommodate different learning preferences.
3. Automate course administrative functions (collecting assignments, assigning grades, etc.) so staff could spend more time working with students.

In order to be successful we had to create an online experience that was as good as or better than the classroom experience. To accomplish this we had to identify features of the classroom experience that were important and find ways to achieve the same effect online.

We have been offering the course online for two years. By most measures our experiment has been a success. Today the course exists in 4 different versions and attracts students from around the United States. Enrollment has gone up 400% since the course was offered in a traditional classroom. Students report a high level of satisfaction with what they learn and with the method of delivery. The technical infrastructure has proven to be a valuable component of the overall course and is being incorporated into other online offerings.

In this paper we report on our experience. We think our most significant result is the demonstration of how online courseware and automation can be used to effectively manage students with a wide range of skills and abilities.

2. How the course works...

Probably the best way to understand how the course works is to follow the path of a typical student.

Step 1 – The student signs up for the course and we mail him/her an introductory letter. The introductory letter gives the student his/her user ID and password. The letter also explains two methods for getting started with the course:

I. The student can access an online new student orientation, or

II. The student can attend an "open lab" for a face-to-face orientation session.

About 77% of new students take the online new student orientation. Open labs are set times when an on campus lab is reserved and students can meet with a staff member to receive personalized help. A prerequisite for *remote* students is that they have enough skills to take the online orientation. There are no prerequisites for local students. Students that don't already have Internet skills can learn them during an open lab or during special face-to-face orientation sessions conducted during the first two weeks of class.

Step 2 – The student studies the online course content. Course content consists of text, pictures, video, audio, animations, and simulations.

Step 3 – The student works on and submits assignments.

There are two types of assignments. The first type is multiple choice true/false. These assignments are graded by the computer and returned to the student immediately. If a question is missed the correct answer is given and in some cases links back to relevant sections of the content are proved.

The second type of assignment requires the student to create a document (word processing, spreadsheet, etc.). Once the student has created the document he/she uploads the file to our server through a web page. Online submission allows us to efficiently receive and organize student assignments.

Through a faculty interface a staff member downloads and grades the assignment.

Step 4 – The student checks back in a few days to see his/her grade and any comments the grader had.

Step 5 – When the student is ready he/she attends an open lab and requests an exam. Remote students make arrangements to take exams from a testing center that is local to them.

In addition to the student and faculty interface, the course also has a proctor interface. Proctors at remote testing centers log on and download exams through the proctor interface. Proctors may also return student exams over the Internet.

Step 6 – We submit grades on semester boundaries. Students who have completed all assignments and all exams receive a grade. All other students receive an incomplete. If more than 9 months goes by and the student hasn't finished the course, that student is assigned a failing grade.

The faculty interface also contains a grading tool. This tool calculates and assigns a grade to everyone who has completed all of the course work. This end-to-end automation makes it very efficient to handle a large number of students or the rush times caused by allowing students to work at their own pace.

We now discuss the most significant features of the course in more detail.

3. Online Content

Having the content online in a digital form allows continuous update to both the content and the presentation of the content. When a student asks a question that is already answered online that is an indication the presentation might be insufficient. Because both the content and the presentation of the content can be continuously updated the quality of online content tends to be very high.

Much of our content is online in multiple forms. For example, students can learn a new word-processing command by reading about it or they can watch a short animation that shows the command being used.

The unique characteristics of the Internet allow for new and innovative types of online content. For example, some topics are presented with an AdaptiveLecture™. An AdaptiveLecture lecture works like this: Before the lecture the student takes a quiz. The lecture is than generated dynamically and includes only the content necessary to answer the questions that were missed. This is better than the student using his/her judgement about what topics to skip, because it directly links topics to competencies.

4. Asynchronous Content

When online content is designed to be asynchronous additional benefits can be realized. The most obvious benefit is students can work at their own pace. Another benefit is that since there are no scheduled class times there is never a schedule conflict with other classes.

Online asynchronous content is changing the definition of a semester. Because the content for our course is online and asynchronous students can start the course at any time. We also allow 9 months to complete the course rather than the 16 weeks of a regular semester. To accommodate the semester system at the University we assign an incomplete for every semester that goes by while the student is still working on the course.

One consequence of having all the instruction and evaluation online we didn't fully anticipate was that students tend to head for the assignments first and refer back to the content only as necessary to complete an assignment. In a traditional classroom instruction usually precedes assignments and students are motivated to concentrate on the instruction in order to prepare for *any* assignment. This made it important for us to design comprehensive assignments that would expose students to all instruction.

5. Time Management

Without a doubt the biggest challenge for us and students is time management. Students aren't accustomed to setting their own schedule for course completion. The tendency is for students to postpone work until the end of the semester and/or the end of the 9-month period in which they have to complete the course. This puts more pressure on students and staff toward the end of a semester.

To quantify this issue we ask incoming students if they plan to complete the course during the current semester. One semester 99% of the incoming students said they planned to complete the course during the current semester. In reality only 75% of the students completed the course by the end of the semester.

Our response to this issue has been to:

1. Encourage regular and steady progress
2. Automate assignment and exam grading to manage the end-of-semester rush that inevitably occurs.

To encourage regular and steady progress we warn students during the orientation lecture that they will be tempted to postpone working on the course. We also make it clear that it's not that there isn't a schedule for the course, but that *they* set the schedule for completing the course.

To capture some of the motivating influence present in a traditional classroom we provide an online class progress page. It shows for all students which assignments and exams they have completed. It doesn't show grades but it does show students how they are doing with respect to the rest of the class.

To help students schedule their time we formatted the course content to fit a 16-week schedule. We also provide a recommended schedule that includes a task list for each week. Students can print the recommended schedule and fill in for each week the expected and actual completion date for each activity.

On the lighter side we post a weekly puzzler to encourage students to visit the web site regularly. Each week we post a new puzzler and answer the puzzler from the previous week.

Because the course is online and asynchronous it attracts students that might not have time for a traditional classroom course. The consequence is that the course self-selects students that are likely to have trouble completing the course in one semester. However, even when you take this into account our experience suggests that the time management issue is one that needs more research.

6. Course Automation

The course incorporates two types of automation:

1. Content Automation, and
2. Infrastructure Automation

Content automation refers to technology that enhances the way content is presented. For example, AdaptiveLectures filter content in a way that personalizes the course to the needs of each student.

Infrastructure automation is the application of office automation techniques to the business of running a course. Infrastructure automation improves the productivity of the staff. Since the course was taught in the classroom enrollment has gone up 400% but staff size has increased by only 50%.

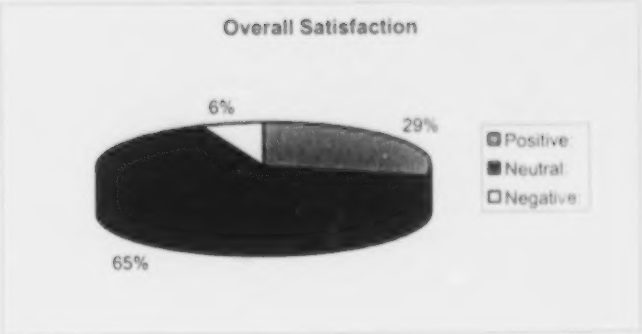
Technology moves fast. Recognizing we were working in a fast moving environment we choose to pick the best technologies and design around well-known interfaces. For example, we use CGI programs to deliver dynamic course content. In the short time we have been offering the online course the preferred technology for delivering dynamic content has changed twice (Perl → C++ → Java) but the interface remains the same. By designing around well-known interfaces we can take advantage of newer technologies without loosing our initial investment.

Most of the automation tools used in the course have been design and build by work-study students from our computer science department. They get real-world project experience and we get custom tools built with state-of-the-art technologies.

7. Student Feedback

Incorporated into the course are various methods of obtaining feedback from students. Students complete a short survey on entrance and exit. Also, as part of one of the course assignments we solicit written comments from the students.

Overall students are satisfied with the course. The following graph summarizes the results of our surveys:



Not surprisingly, the issue of time management came up the most. The following quote from one student summarizes it best:

> *This course has taught me several things. I have learned many new skills on the computer, but most of all I have learned the importance of being responsible even when I am not being watched. With this course being strictly over the Internet it has been really easy to slip behind in the course work. As students I think that we are used to being in a structured classroom where our progress is closely monitored. This class allows the student freedom to complete work at their own pace while teaching them responsibility.*

Not all comments were positive. Most of the negative comments dealt with the frustration of working in a public lab or the increased difficulty of learning from a computer as compared to learning in a classroom. The following comment by one student characterizes this latter sentiment:

> *I have not taken an Internet course before, and I probably won't again. It has been difficult to follow the lessons and toggle to Word to apply. I have found that in my computer experience, I learn better in a one on one situation.*

What was not made clear to this student was that he or she could receive practically unlimited personal instruction during the lab times that we reserve for open labs. Because of the high productivity gains from course automation we could easily afford to hire a personal tutor for every student that expressed dissatisfaction with the online format.

8. Conclusion

Increasingly educators are being asked to teach students with diverse skills and abilities. For the past two years we have been teaching an introductory computer class online. The online format has helped us manage diverse student needs because:

1. Online asynchronous content allows students to work at their own pace
2. Multimedia types and innovative teaching tools accommodate different learning styles
3. Automating routine teaching and administrative tasks allows staff more time to work directly with students

How to recapture in an online course the motivating influence of regularly scheduled classes remains a research issue.

Planning, Implementing, and Evaluating an Internet Inservice Workshop

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Abstract: As part of the cooperation between the University of South Dakota School of Education and regional school districts, in the fall of 1998 an inservice training program was conducted to enable elementary and high school teachers to incorporate Internet resources into their courses. Training principles drawn from scholarly literature were utilized, and the training was evaluated to assess the degree of success achieved.

1. Introduction

A faculty member of the Division of Technology for Training and Development (TTD) in the School of Education at the University of South Dakota (USD), this author was asked to join another TTD professor to create a training program. The new superintendent of Centerville school district wanted his schoolteachers to become aware of the Internet's use as a teaching tool, understand how it works, and utilize it to enhance and modernize their curriculum. The training was part of the Fall 1998 inservice program. The Centerville schools Centerville had been conservative in acquiring technology, but the new superintendent worked to install various innovations, including computer laboratories both for elementary and high school. The training request was for the USD professors to prepare a 15-contact-hour workshop that would allow the option for participants to pay tuition and count the inservice as a one-credit class. Although the requested training would not completely fulfill the teachers' needs for training nor enable them to effectively incorporate technology elements into their curriculum, USD was happy to be asked for participation. The TTD division at USD has founded and maintains the Professional Development Center, which works closely with the local schools to improve teacher training. While performing this function, the TTD team has seen local instances of a common problem. Schools sometimes spend most of their budget on hardware and software acquisition, and then do not have enough financial resources to train teachers and staff how to use the technology. The problem seems to be more evident in districts with very limited budgets. They prioritize the purchase of the hardware and software and are immediately reinforced by parent and community satisfaction, but very soon they start wondering why the equipment is not being used [Miller 1996] [Oliver 1997] [Roberts 1985].

2. Workshop Participants and Schedule

The teachers were divided into elementary and high school groups. This paper will address only the 17-member high school group, since that is the group that this author was in charge of. The first workshop session, because it happened before school started, was planned for two consecutive days at USD with a total duration of 9 hours, 6 the first day and 3 the second. The remaining 6 hours were scheduled to be at Centerville during the semester in two-hour sessions after school hours. The school, as a way of showing support and emphasizing the high priority of the technological workshops, provided transportation and lunch arrangements for the entire group.

Before the course started, the superintendent informed the trainers of the disadvantage that the level of computer skills of the entire group was very low. On the other hand, a strong training advantage would be available in the form of the computer laboratory at the school, where the final 6 hours of training would take place and which would be available both for classroom activities and for independent practice. The first two days of training were to be held at the USD facility, a computer-equipped classroom containing 17 Windows-based computers and 3 Macintoshes as well as an overhead projector connected to the teaching station, which allowed an enlarged view of the computer screen. Netscape was the browser installed on all the computers.

3. Planning

The situation freed the trainers from having to deal with the common training burdens of scheduling, participant selection, and budget [Holmes & Duffey 1993] [Bradford, Kannon, & Ryan 1996], but it had the disadvantage of not allowing them to cover important aspects of adult training effectiveness like previous knowledge of the participants, familiarity with participant motivation, and, most importantly, the individual background that each trainee brings to the workshop [Knowles 1987].

Having been informed that the participants were inexperienced with computers and new to the Internet, the trainers to carefully considered basic design elements when laying out the training plan. Research shows that the more computer-naive the audience is the more detailed the training program has to be in order to be efficient [Humbert & Kefferstan 1995]. Therefore, the topics covered in the training sessions started from point zero. Foreseeing a wide diversity in interest and learning rates on the part of the group members, however, the trainers also included techniques to attend the needs of learners with different levels of knowledge and skills. The training topic was the Internet and its potential use as an educational tool, so a Web page seemed to be the logical vehicle to introduce the program to the participants.

For a training program to make an impact on performance it needs to provide support to optimize the trainees' memory function. This allows them not only to understand the content but also internalize the essential steps that allow them to transfer the acquired skills from the training to their daily activities. When training delivers a large amount of information, sometimes the trainees are unable to incorporate the necessary information into their memory and the training does not produce the desired effect. Providing adequate opportunities for rehearsal, for example, contributes to the success of training by offering the trainees a chance to transfer training course information and skills and carry them into post-training experiences [Clark 1995]. Online Internet tutorials were used to delivers some of the training content, which permitted the participants to explore the topics at their own pace and interacting with the training instead of passively receiving an instructor's lecture. Because the content was available on-line the learners could also visit the page and its associated resources at will from home.

4. Implementing

The teachers were informed about the planned activities for the two-day training and that the Web page containing all of the training material would be available to them from anywhere they had an Internet connection. They were then asked to pair with someone and explore an on-line tutorial that gave them an overview of the Internet. The trainer, observing the principle that adult learners need to feel in control of their learning process, asked the group members to pair with the person they thought most appropriate [Knowles 1987]. The opportunity for hands-on activities seemed to please the group, reinforcing the findings of [Tomei 1996], who points out the importance of hands-on training when promoting teachers' use of technology in the classroom. The trainer answered questions, provided help when asked for it, solved problems that arose, but functioned as a coach and resource rather than a conventional teacher. For pairs who were more knowledgeable about the Internet, the hyperlinks in the tutorial allowed branching to more advanced topics. Bookmarking was chosen for coverage beyond that of the tutorial and was the second activity of the workshop. The trainer walked the group through adding, filing, and editing bookmarks, and the group members immediately saw how they could identify important resources and organize them for easy retrieval in the future.

The third workshop activity, and one that the teachers largely appreciated, was downloading files from the Internet. The trainees practiced downloading clip-art images and , to give some practical point to the exercise, opened a word processor, inserted the downloaded pictures into text documents, and printed the result. They became quite enthusiastic as they realized the Internet held a huge assortment of images available to them from millions of Web sites all over the world. During this activity, the group also practiced downloading and installing programs that they could get free from Web sites. For this, as well as every other activity, the group was always stimulated to think of ways that they could apply the skill just learned in their daily activities.

The fourth workshop topic was using the various Internet search tools. It is a paradox that the Internet, a nearly infinite repository of information, is often the subject of complaints that it has so much information that the user cannot find anything. Although there is some basis for these comments, the fact is that the Internet has an enormous capacity for efficient data retrieval. It is also a fact that some training is required to learn which search devices are best to find given types of data. Yahoo!, for example, one of the first and still perhaps the most popular search resource, is a search directory, which means it searches through Web sites that have been submitted by Website owners and that have been accepted into its system according to criteria determined by Yahoo! If one knows with relative accuracy what one is looking for, a search directory is usually a better choice because the information is already organized and indexed by subject. If one has only a vague idea of what one is looking for, however, a search engine like AltaVista is probably a better choice. A search engine matches the search keywords with sites on the entire Web, returning a correspondingly larger volume of responses, an analysis of which can be used to concretize one's idea, determine appropriate new or added keywords, and refine one's search to retrieve responses that provide the desired support for one's research. In other words, knowing which of the search tools that the Internet makes available best serves one's specific search need allows one to fill that need more quickly and completely. The search topic was delivered to the group through an MS-PowerPoint presentation that was uploaded to the Web. The group also had the opportunity to discuss briefly what would be involved in using search tools in the classroom.

The fifth topic covered in the workshop was e-mail. The group was provided a link to "hot-mail," where they could get e-mail for themselves and go through an on-line tutorial to learn how to operate the e-mail interface. A flood of possibilities to use e-mail in the classroom sprang spontaneously from the participants while they were involved in this activity, and after finishing the tutorial they immediately became so engaged exchanging messages among themselves that it was difficult to move to the next topic of the workshop.

The millions of Web sites on the Internet represents an enormous variety of taste and quality, which suggests that some attention should be paid to Web-site evaluation. As the last activity of the first day the teachers were provided with an electronic form to do such evaluation. They were also provided with a list of three sites containing school-related material. They were asked to pair with someone and visit at least three different sites and then fill out the evaluation form.

Having learned the mechanics of Internet navigation, Internet search, and Internet evaluation on the first day, the teachers were prepared for the second day of training, in which they were expected to put together a lesson plan that used Internet resources in its execution. The second day began with a short lecture about integrating technology into the curriculum. The teachers were then asked to pair with a colleague and, working together, plan a lesson using Internet resources as the principal content.

5. Results

In order to assess the influence of the training on the participants, a survey was applied at the beginning and at the end of the first nine hours of training. The instrument had 27 items, the first 12 of which were to measure the teachers' general feeling toward the Internet. The next 11 items were devised to measure the teachers' skill level on Internet functions. The last four items were planned to measure the teacher's knowledge of how to apply Internet resources to a curriculum.

The pre-test survey results for the first 12 items show that the high school group had a generally positive attitude about the Internet and the use of it into their curricular activities. The 12 items break down as follows:

- Seventy-one percent agreed or strongly agreed that the Internet is necessary in today's society.
- Eighty-two percent disagreed or strongly disagreed that teachers resent being forced to use the Internet.
- Seventy-one percent agreed that teachers are glad to learn how to use the Internet in their teaching.
- The teachers split on whether students take the Internet seriously; 47% disagreed and 41% agreed.
- Eighty-eight percent agreed or strongly agreed that the Internet is a powerful teaching tool.
- Sixty-five percent disagreed that the Internet is harmfully distracting in teaching traditional material.
- Seventy-six percent disagreed or strongly disagreed they lacked time to put the Internet into teaching.
- They did not see the Internet as a confusing environment, as confirmed by 76% of their answers.
- The teachers also confirmed with 76% of their answers that they like using the Internet.
- Ninety-four percent of the teachers indicated that access to the Internet should be carefully controlled.
- Seventy-one percent thought that the Internet was as important as the school library.
- More than half of the group, 65%, thought that books are not a better study resource than the Internet.

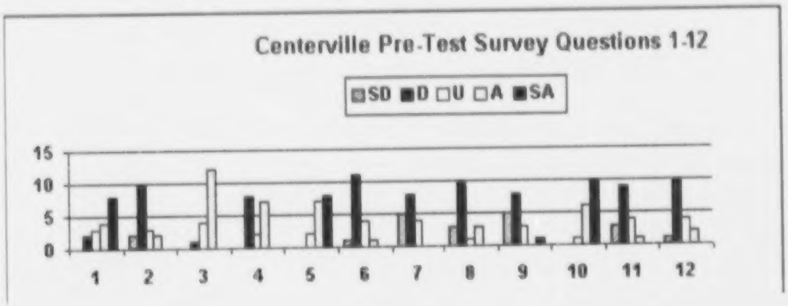

Figure 1: Centerville pre-test survey questions 1-12

The post-test survey results for the first 12 items does not show a significant difference from the pre-test results. There was an increase of uncertainty about teachers' resenting being forced to use the Internet in their classes, with "uncertain" answers jumping from 18% on the pre-test to 41% on the post-test. A slight difference occurred in the responses to the statement that the Internet is confusing; 59% disagreed pre-test, , 82% post-test.

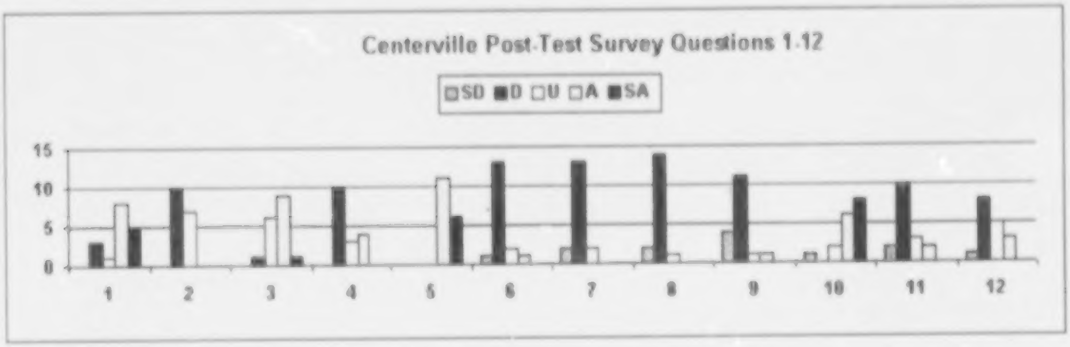

Figure 2: Centerville post-test survey questions 1-12

The next 11 items in the survey instrument were meant to verify the level of skill of the participants. The group's answers to this set of items confirmed that they were naive in terms of Internet usage. The results were the following:

- Eighty-eight percent (12% uncertain, 41% disagree, 18% strongly disagree) did not understood the logic of Internet site naming.
- Eighteen percent were uncertain, 29% disagreed, and 18% strongly disagreed that they knew how to get where they wanted to go on the Internet, but 35% indicated no Internet navigation problems.
- Twelve percent were uncertain, 41% disagreed, and 12% strongly disagreed that they were comfortable about using the Internet as a resource, but 29% indicated comfort in using the Internet as a resource.
- Twelve percent were uncertain, 59% disagreed, 18% strongly disagreed they could use bookmarks.
- Ninety-four percent of the respondents indicated they did not know how to download Internet files.
- While 24% said they could print Internet pages, 71% were uncertain, disagreed, or strongly disagreed.
- Although 24% agreed they could retrieve data from the Internet, 71% were uncertain or could not.
- The vast majority, 88%, did not know or were uncertain how to save resources from the Internet.
- Seventy-six percent indicated they did not know or were uncertain about how to do an Internet search.
- Seventy-one percent professed ignorance or uncertainty about how to use Internet search tools.
- Nearly all, 94%, were ignorant or uncertain about the difference between Intranet and the Internet.

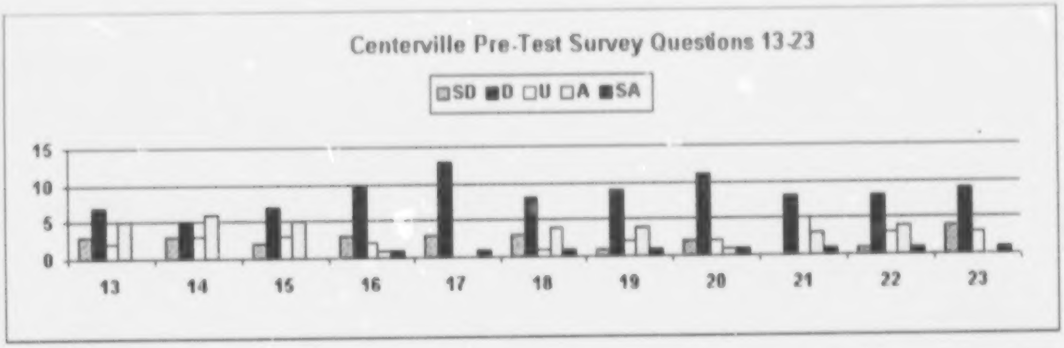

Figure 3: Centerville pre-test survey questions 13-23

The items represented in Figures 3 and 4 are designed to measure amount of Internet skills, and there was a positive difference between the pre- and post-test answers, especially on the following five items:

- Pre-test, 71% indicated discomfort using the Internet as a resource. Post-test, 71% were comfortable.
- Pre-test, 88% did not know how to use bookmarks. Post-test, 71% had learned that skill.
- Pre-test, 71% said they could not retrieve resources from the Internet. Post-test, 71% could.
- Pre-test, 76% could not effectively conduct an Internet search. Post-test, 76% said they could.
- Pre-test, 71% could not use the Internet search tools. Post-test, 88% reported that they could.

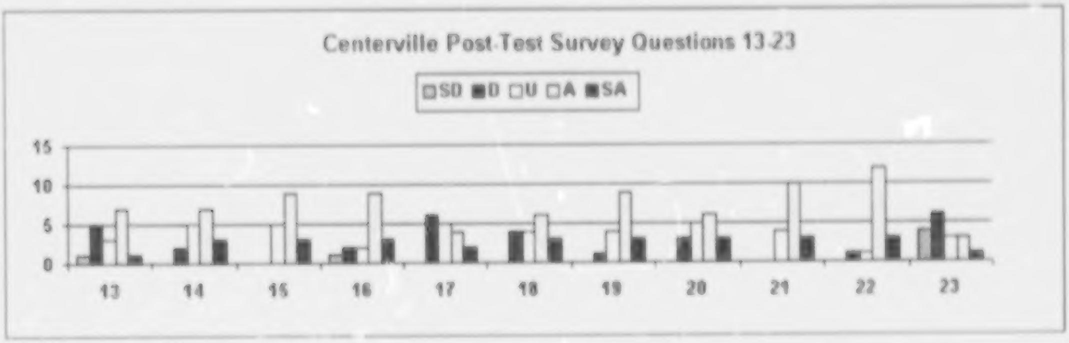

Figure 4: Centerville post-test survey questions 13-23

The following final set of four survey items was meant to measure the trainees' ability to integrate Internet resources into the curriculum.

- Eight-eight percent indicated they could not set up a lesson using the school intranet.
- Seventy-one percent indicated they could not do class presentations using Internet elements.
- Eighty-two percent indicated they could not guide their students through a hands-on Internet exercise.
- Eight-two percent indicated they could not integrate the Internet into the curriculum.

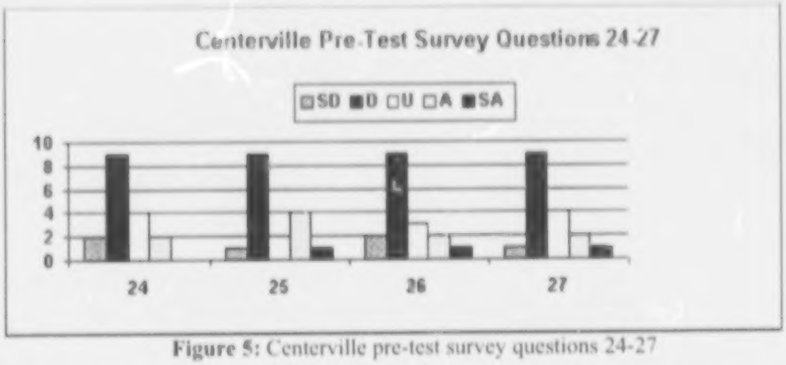

Figure 5: Centerville pre-test survey questions 24-27

In respect to these four items, the training appears to have been effective. The percentages for these items changed from negative (uncertain, disagree, strongly disagree) on the pre-test to positive (agree, strongly agree) on the post-test. Going through the items in order, the shift was from 88% negative to 53% positive, 71% negative to 65% positive, 82% negative to 53% positive, 82% negative to 65% positive.

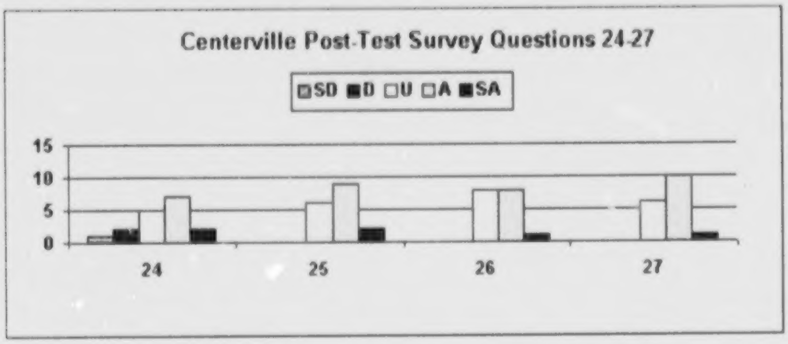

Figure 6: Centerville post-test survey questions 24-27

6. Conclusion

When conducting an inservice workshop for schoolteachers to learn about and use the Internet in their professional activities, including adult learning principles described by [Knowles 1987], findings of research into the degree of computer skill within the training group [Humbert & Kefferstan 1995], observations of [Clark 1995] on the methods and importance of assuring continuity of skill acquisition in post-training activities, and data presented by [Tomei 1996] about the use and importance of hands-on activities proved to be elements that promoted success. Although the results of the pre- and post-tests showed no significant change in attitude, the same tests indicated positive results in the areas of skill acquisition and using the Internet in curricular applications.

7. References

[Bradford, Kannon, & Ryan 1996] Bradford, J., Kannon K. E., & Ryan, S. M. (1996). Designing and implementing a faculty Internet workshop: A collaborative effort of academic computing services and the university library. Research Strategies, 14 (4), 234-245.

[Clark 1995] Clark, R. C. (1995). Twenty first century human performance. Training, 32 (6), 85-90.

[Holmes & Duffey 1993] Holmes, K., & Duffey, D. 1993. Technology staff development: Designing an effective process (Tech. Rep.). Denton: University of North Texas, Texas Center for Educational Technology.

[Humbert & Kefferstan 1995] Humbert, R. A. , & Kefferstan, R. D. (1995). Training: Reaching the haves and havenots. (Eric Document Reproduction Service No. ED 385 218.)

[Knowles 1987] Knowles, M. S. (1987). Adult learning. In R. L. Craig (Ed.), Training and Development Handbook (3rd ed., pp.168-179). New York: McGraw-Hill Book Company.

[Miller 1996] Miller, J. A. (1996). Online, off-track. Techniques: Making Education and Career Connections, 72 (7), 13-15.

[Oliver 1997] Oliver J. (1997). 10 'must ask' questions when developing a technology plan. The School Administrator, 54 (4), 26-29.

[Roberts 1985] Roberts, L. G. (1985). Training of teachers in instructional use of technology. (Eric Document Reproduction Service No. ED 297 694.)

[Tomei 1996] Tomei, L. A. (1996). Time for action. Momentum, 27(2), 53-55.

An Adaptive Driving Course Based on HTML Dynamic Generation

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Abstract: In this paper we describe a new approach for developing adaptive Web based courses. These courses are defined by means of teaching tasks which correspond to basic knowledge units, and rules which describe how teaching tasks are divided into subtasks. Both tasks and rules are used at execution time to guide the students during their learning process by determining the set of achievable tasks to be presented to the student at every step. Adaptivity is implemented by presenting students with different HTML pages depending on their profile, their previous actions, and the active learning strategy. The HTML pages presented to the students are generated dynamically from general information about the type of media elements associated to each task and their layout. The whole approach is exemplified by means of a course on traffic signs.

1. Introduction

Since it was born, the World Wide Web has been used for learning because it allows students to have access to a great variety of information sources [Llamas et al. 1996][Vassileva 1997]. However, an Internet based learning system will be effective not only if it allows students to navigate between different pages but also if it helps students to achieve better their learning goals. It is true that a good design of the navigation space helps, but it is also necessary to provide more sophisticated mechanisms that modify the navigation alternatives by some sort of adaptation procedure.

There are important differences among students. Some of them are related to personal features as age, interests, preferences, etc and to their previous knowledge (if any) about the subject [Nill 1997][Eklund &Brusilovsky 1998]. There are others which have to do with their preferences for a specific learning strategy.

One of the desirable features of any Web based educational system is adaptivity, i.e. the ability to take into account all the above-mentioned features in order to customize the course contents as well as their presentation format [Brusilovsky 1997]. Different approaches have been proposed to incorporate adaptivity into hypermedia courses. One of them is the technique of sensitive links that are used to establish links between hyper-documents whose availability and contents change depending on the state of the teaching [Brusilovsky et al. 1996][Brusilovsky & Anderson 1998]. Other approaches use typed and weighted links to link concepts to documents and to other concepts [da Silva et al. 1998]. The student's knowledge of each concept is used to guide him/her towards the appropriate documents.

This paper describes an alternative approach to the construction of tutoring systems, which is based on the use of teaching tasks and rules in order to guide the learning process towards the desired goals. This approach has been implemented in the TANGOW system, Task-based Adaptive learNer Guidance On the Web [Carro et al. 1999a] [Carro et al. 1999b]. Courses designed by using TANGOW are dynamically adapted to each student by taking into account his/her profile and actions, as well as different teaching strategies.

2. Course design

When creating a new course, the designer must (1) make a conceptual decomposition of the course into tasks, and (2) establish the relation between tasks by means of rules. These steps will be described in the next two sections.

2.1 Teaching tasks

A teaching task is the basic unit in the learning process. A course is defined as a global task to be performed. Tasks can be decomposed into subtasks and students must perform some or all the subtasks to get the main task performed. A task can be defined by giving value to some general attributes such as its name, description, content type, composition type, and ending requirements. Content type distinguishes between theoretical, practical and example tasks. According to the composition type, tasks may be atomic or composed. Finally, ending requirements are implemented by means of functions which decide, at runtime, whether tasks have been completed. This decision is based on parameters directly related to student actions, in the case of atomic tasks, or on subtask finalisation, if the task is composed.

Teaching tasks have other specific attributes which include a list of media elements (text, images, videos, applets, sounds, animations, ...) which will be used for HTML page generation. The way in which these elements will be combined to construct the final pages is described by means of a description language which specifies their relative positions. If any of the media elements corresponds to an exercise, the correct answer is also given. This can be compared to the AHA system [de Bra & Calvi 1998] where filters for content fragments are encoded by means of conditional sentences included as comments in HTML pages. The main difference with our approach is that we create the HTML pages by linking media elements, whereas in the AHA system the pages are already created and it is decided at runtime which portions of them are shown to the student.

A course on traffic signs has been developed for demonstration and can be tested at http://helena.ii.uam.es/html/courses.html. The description of two tasks belonging to this course is shown in [Fig. 1]. The 'Circular signs' task is an example of a theoretical atomic task. Its final requirements associated function ('f_teo') will receive several input parameters such as the number of pages visited so far by the student ('pag_visited') and the total number of pages related to the task ('tot_pag'). The media elements used to generate the HTML pages related to this task appear as values for the HTML field. They will appear in a sequence up-down (M1).

A different example is the 'Traffic Agents: Exercises' task which corresponds to a practical task which contains exercises related to traffic agents. It is an atomic task. The input parameters of its final requirements method ('f_prac1') are the number of exercises done by the student ('exer_done'), the number of exercises correctly solved ('exer_ok'), and the total number of exercises that are available ('tot_exer'). The media elements as well as the correct answer for each exercise are specified as values for the HTML field.

```
NAME = CIRCULAR_SIGNS
TYPE = T
ATOMIC = Y
DESCRIPTION =  Description of circular signs
END_METH =     F_TEO
PARAMS = pag_visited
         tot_pag
HTML = CIRCULARES     M1
           STOP       M1
           C_PROHI    M1
           E_PROHI    M1
           EP_VEHI    M1
           EPV_SIDE   M1
```

```
NAME = TRAFFIC_AGENTS_EXERCISES
TYPE = P
ATOMIC = Y
DESCRIPTION = Exercises about signals by traffic agents
END_METH = F_PRAC1
PARAMS = exer_ok
         exer_done
         tot_exer
HTML = eA1     a      M1
       eA2     b      M1
       eA3     c      M1
       eA4     b      M1
       eA5     a      M1
```

Figure 1: Two different task descriptions

2.2. Rules

Task decomposition is represented by means of rules. Each rule is given a name and includes information about the task to be divided ('LHS'), the list of subtasks that are part of the task ('RHS') and a keyword corresponding to the sequencing of the subtasks ('SEQUENCING'). XOR indicates that only one of the subtasks must be performed, OR means that at least one of the subtasks must be performed, AND indicates that all the subtasks must be performed in the order they appear in the list, and ANY indicates that all the subtasks must be performed, but that they can be performed in any order. In addition, the course designer can specify a precondition that has to be satisfied for initiating the task ('ACT_CONDITION') and the parameters ('PARAMS') used for evaluating this precondition (which may be taken from other tasks results). The last rule attribute ('CALC_PARAMS') indicates how parameter values for tasks in the RHS of the rule are propagated to the task in the RHS.

The description of two rules in the driving course is shown in [Fig. 2]. Rule R0 indicates that the 'Types' task is decomposed into three subtasks: 'Circumstantial Signs', 'Vertical Signs' and 'Traffic Agents'. The student must perform the three subtasks, but (s)he can do it in any order. There is no precondition for the rule to be activated, and the propagation of parameters from the RHS to the LHS of the rule is done by adding the values of homonym parameters. In rule R1, the precondition 'c_4' indicates that the rule will be active only if the execution of method 'c_4' returns true when it is given the value for the 'exer_ok' parameter from 'Vertical_Signs' as input.

```
NAME = R0
SEQUENCING =  ANY
LHS =    Types
RHS =    Circumstantial_Signs
         Vertical_Signs
         Traffic_Agents
CALC_PARAMS= time_in   msum3  time_in  Circumstantial_Signs
                              time_in  Vertical_Signs
                              time_in  Traffic_Agents [...]
```

```
NAME = R1
SEQUENCING= AND
LHS =    Circumstantial_Signs
RHS =    Circumstantial_Signs_Theory
         Circumstantial_Signs_Exercises
ACT_CONDITION = c-4
PARAM =  exer_ok      Vertical_Signs

CALC_PARAMS = [...]
```

Figure 2: Two different rule descriptions

Details about all the tasks and rules of the driving course can be found at the following address http://www.ii.uam.es/~rcarro/Webnet99/TaskTree.html, where each cell corresponds to a task. Those rules in which the task appear at the LHS of the rule (or the RHS) are written above (or below) the task name.

3. Why do we call it "adaptive"?

The set of tasks that the student is offered to tackle at a given moment can vary depending on the student profile, the current teaching strategy, actions performed by the student when tackling specific tasks, and the course design.

3.1. Student profile

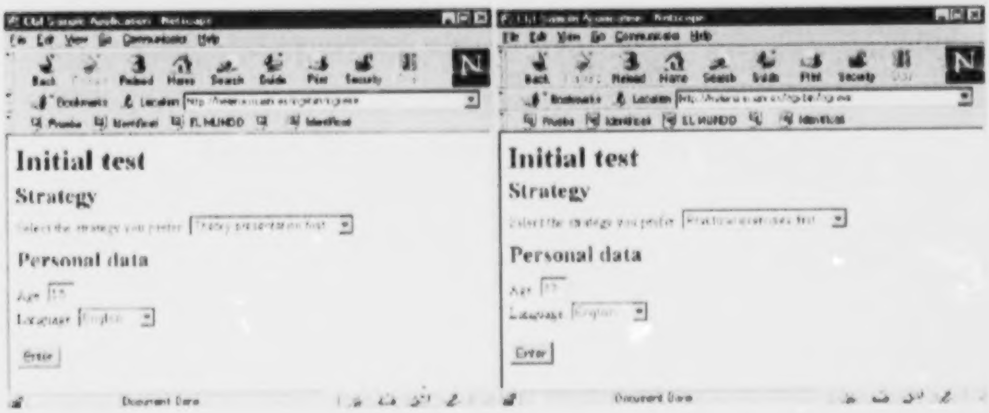
The student profile includes personal features such as the student age and native language, the relation between the student and the studied subject, etc. The first time that a student enters a course, (s)he is presented with a test where some personal data and preferences fields must be filled. [Fig. 3] shows the test as filled by two different students.

A task may be defined in different ways depending on one or more of these features. As an example, in the traffic signs course, the "Traffic Signs" task is defined by means of two different rules:

(RR1) Traffic Signs -> Types, Priority
(RR2) Traffic Signs -> Types, Priority_Theory

The "Priority" task is defined by rule RP.

(RP) Priority -> Priority_Theory, Priority_Examples



Initial test

Strategy

Select the strategy you prefer

Personal data

Age

Language

Enter

Initial test

Strategy

Select the strategy you prefer

Personal data

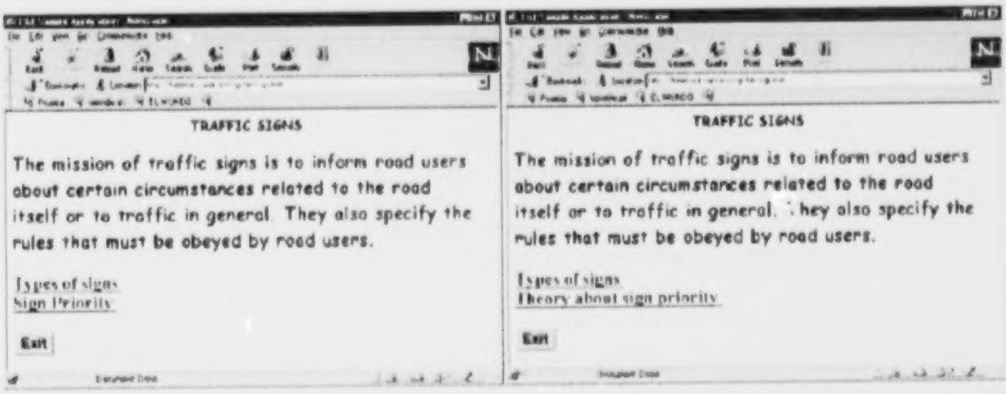
Age

Language

Enter

Figure 3: Different student profiles

Both rules RR1 and RR2 have an activation condition which depends on the student's age. This means that the "Signs" task may be achieved in two different ways depending on the student's age. Basically, if the student is younger than 18, (s)he will be presented with examples about the priority of signs. Otherwise, (s)he will study only theoretical aspects on the same subject (see [Fig. 4]).



TRAFFIC SIGNS

The mission of traffic signs is to inform road users about certain circumstances related to the road itself or to traffic in general. They also specify the rules that must be obeyed by road users.

Types of signs
Sign Priority

Exit

TRAFFIC SIGNS

The mission of traffic signs is to inform road users about certain circumstances related to the road itself or to traffic in general. They also specify the rules that must be obeyed by road users.

Types of signs
Theory about sign priority

Exit

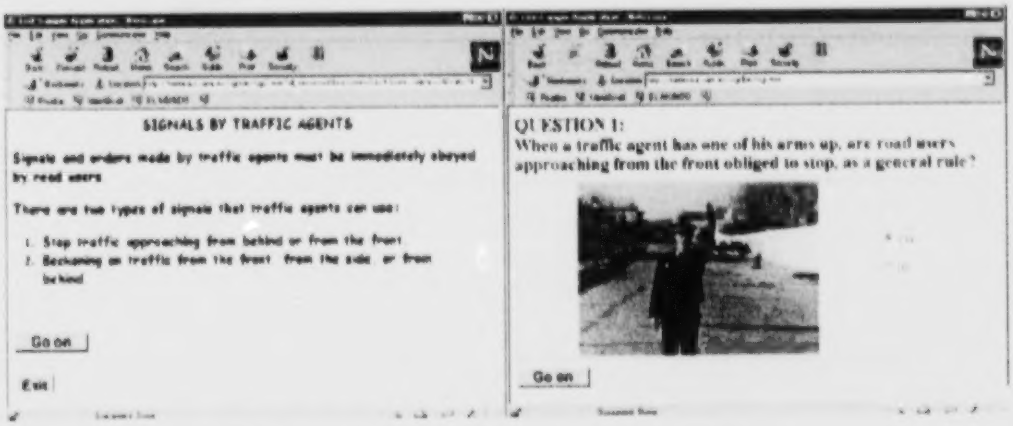
Figure 4: Adaptivity based on student profiles

3.2. Teaching strategy

Teaching strategies have an effect on the order in which subtasks are performed. For example, if the "theoretical before practical" strategy is being used, the student will be presented with theoretical tasks first, and only after they have been performed, (s)he will be able to tackle practical tasks. Similarly, for the "practical before theoretical" teaching strategy (see [Fig. 3] and [Fig. 5]).

3.3. Student actions

A task may be included in the set of achievable tasks at a given moment depending on actions previously performed by the student when tackling a different task. For example, we may decide that a student can only learn about circumstantial signs if (s)he has successfully solved a number of exercises related to vertical signs (see [Fig. 6]). Note that, in contrast to figure 6a, in figure 6b, the "Description of vertical signs" task is not in the choice set. The reason for this is that the task has already been performed. The "Circumstantial signs" task is accessible because the student has solved correctly the exercises associated to the "Description of vertical signs" task. Other student actions may be related to the time a student has spent learning a task or the number of pages he/she has visited.


SIGNALS BY TRAFFIC AGENTS

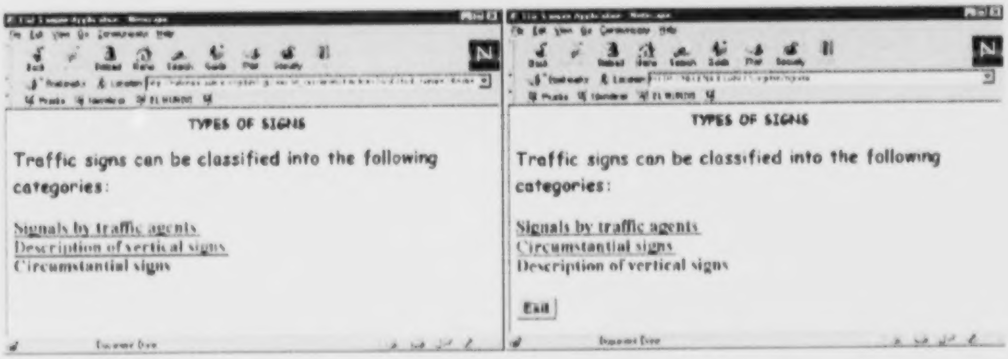
Signals and orders made by traffic agents must be immediately obeyed by road users

There are two types of signals that traffic agents can use:

1. Stop traffic approaching from behind or from the front
2. Beckoning on traffic from the front, from the side, or from behind

QUESTION 1:
When a traffic agent has one of his arms up, are road users approaching from the front obliged to stop, as a general rule?

Figure 5: Adaptivity based on the learning strategy


TYPES OF SIGNS

Traffic signs can be classified into the following categories:

Signals by traffic agents
Description of vertical signs
Circumstantial signs

TYPES OF SIGNS

Traffic signs can be classified into the following categories:

Signals by traffic agents
Circumstantial signs
Description of vertical signs

Figure 6a and 6b: Adaptivity based on student actions

3.4. Course design

The sequencing specified by the course designer has a great influence in the set of tasks that are offered to the student at a given moment. Initially, when the active task appears in the LHS of a rule with ANY, XOR, or OR sequencing, all the achievable subtasks in the RHS are offered to the student. This is the case for some of the preceding figures. However, if the rule sequencing is AND, only the first subtask in the RHS of the appropriate type (according to the current strategy) and that has not been performed will be made available.

In subsequent steps, three different cases can appear. If the rule sequencing is ANY or OR, the remaining subtasks will be offered to the student by presenting him with a menu page. If the sequencing is ANY and there is only one task left, then the system takes you directly to the information associated with it. In the case of OR sequencing, the student has the chance of exploring new paths before continuing with his (her) learning itinerary. If the rule

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sequencing is AND, the student will be offered a single subtask which will be chosen from the RHS of the rule depending on the active teaching strategy. Note that if the rule sequencing is XOR, there is no need to offer additional tasks to the student.

4. Work in progress

The mechanism of teaching tasks presented in this paper adds adaptability to interactive courses, by controlling events about the keystones reached by students at different stages of their learning process.

Work is continuing on the presented system with the immediate goals of (1) extending it so that the teaching strategy may be modified at runtime, and (2) allowing the students to revisit tasks already performed by including frames with task lists in every dynamically generated HTML page.

References

de Bra, P. & Calvi, L. (1998). AHA: A Generic Adaptive Hypermedia System, *Second Workshop on Adaptive Hypertext and Hypermedia*, pp. 5-11. Ninth ACM Conference on Hypertext and Hypermedia, Pittsburgh, USA, June 20-24, 1998.

Brusilovsky, P. (1997). Distributed intelligent tutoring on the Web, *8th World Conference of the AIED Society*, Kobe, Japan, August 1997, http://www.contrib.andrew.cmu.edu/~plb/AIED97_workshop/Brusilovsky/Brusilovsky.html

Brusilovsky, P. & Anderson, J. (1998). ACT-R electronic bookshelf: An adaptive system for learning cognitive psychology on the Web, *WebNet 98 World Conference of the WWW, Internet & Intranet*, pp. 92-97, Orlando, Florida, November 7-12, 1998.

Brusilovsky, P., Schwarz, E. & Weber, G. (1996). A tool for Developing Adaptive Electronic Textbooks on WWW, *WebNet-96* of the AACE, http://www.contrib.andrew.cmu.edu/~plb/WebNet96.html.

Carro, R.M., Pulido, E. & Rodriguez, P. (1999a) TANGOW: Task-based Adaptive learNer Guidance On the Web, *Second Workshop on Adaptive Systems and User Modeling on the Web* at the Eighth International World Wide Web Conference. Toronto, Canada, May 11-14, 1999.

Carro, R.M., Moriyón, R., Pulido, E. & Rodriguez, P. (1999b) Teaching Tasks in an Adaptive Learning Environment, *8th International Conference on Human-Computer Interaction*, HCI International '99, Munich, Germany, August 22-27, 1999, forthcoming.

Eklund, J. & Brusilovsky, P. (1998). The Value of Adaptivity in Hypermedia Learning Environments: A short Review of Empirical Evidence, *Second Workshop on Adaptive Hypertext and Hypermedia*, pp. 13-19. Ninth ACM Conference on Hypertext and Hypermedia, Pittsburgh, USA, June 20-24, 1998.

Llamas, M., Fernández, M.J., Gil, A., Rodriguez, R. & Suárez, A. (1996). A Cost-effective Approach to WWW Education and Training, Proceedings of the 3rd International Workshop on Protocols for Multimedia Systems (PROMS'96), October 1996.

Nill, A. (1997), *Providing Useable and Useful Information by Adaptivity and Adaptability*, GMD- German National Research Center for Information Technology, Sankt Augustin, Germany, http://zeus.gmd.de/~nill/flexht97.html

da Silva, D.P, Van Durm, R., Duval, E. & Olivi, H. (1998). Concepts and documents for adaptive educational hypermedia: a model and a prototype, *Second Workshop on Adaptive Hypertext and Hypermedia*, pp. 35-43. Ninth ACM Conference on Hypertext and Hypermedia, Pittsburgh, USA, June 20-24, 1998.

Vassileva, J. (1997). Dynamic Courseware Generation on the WWW, *8th World Conference of the AIED Society*, Kobe, Japan, August 1997. http://www.contrib.andrew.cmu.edu/~plb/AIED97_workshop/Vassileva/Vassileva.html

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Third Generation Adaptive Hypermedia Systems

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Abstract: This paper examines the development of adaptive hypermedia systems and proposes adaptive characteristics for third generation adaptive hypermedia systems. First generation adaptive hypermedia systems predated the World-Wide Web (WWW) and were primarily single user adaptive hypermedia systems. Second generation systems have exploited the distributed nature and ease of authoring of the WWW to develop more robust and mature adaptive hypermedia systems. While these systems are a dramatic improvement over first generation systems, they have several limitations that limited the effectiveness of adaptation. These limitations include limited adaptation through one-dimensional, stereotypical user models, coarse granularity of adaptive support, closed adaptive hyperspaces with sharp boundaries, limited authoring support, and limited and non-constructive communications between the user and the adaptive model. Third generation adaptive hypermedia systems must address these shortcomings to fully exploit the potential of adaptive hypermedia. Future systems must provide explicit, fine-grained adaptation support that the user can easily tailor and refine to provide highly relevant multidimensional adaptation. Future adaptive hypermedia systems must be open systems with soft boundaries that are expandable and incorporate resources from non-adaptive hypermedia with gradual degradation of support. Finally, adaptive systems must be relatively easy to build and maintain. This paper examines these characteristics of future adaptive hypermedia systems and proposes a framework for development.

1. Background

1.1 First Generation Adaptive Hypermedia Systems

Numerous adaptive hypermedia systems have been implemented over the last fifteen years. These systems can be characterized as first generation or second-generation adaptive hypermedia systems based on when they were developed and what delivery mechanism was used for deployment of the systems. First generation systems span the period from 1985-1993 and are principally adaptive systems that were not distributed in nature. These systems were generally PC or Macintosh-based provided limited adaptability through stereotype-based user models and limited functionality adaptation techniques such as conditional text filters, direct guidance, stretchtext, hiding, and primitive link annotation. EPIAIM [Rosis et al. 1994], Hypadapter [Bocker et al. 1990], ITEM/IP [Brusilovsky 1992], ISIS-Tutor [Brusilovsky and Pesin 1994; Brusilovsky and Pesin 1994], MetaDoc [Boyle and Encarnacion 1994], and MetaDoc V [Boyle and Teh 1993] are examples of first generation adaptive hypermedia systems.

ISIS-Tutor is a good example a first generation adaptive system. It is an adaptive learning environment for the information retrieval system CDS/ISIS/M (ISIS) [Brusilovsky and Pesin 1994; Brusilovsky and Pesin 1994]. ISIS-Tutor provided adaptive support through frame-based presentation, link annotation, and information hiding. It presented an adaptive sequence of tasks and concepts based on the user model and maintained a four state, user knowledge model (not-ready-to-be-learned, ready-to-be-learned, in-work, and learned) on each concept within ISIS. As the user progressed through the system, ISIS-Tutor annotated each concept with color and hiding could be enabled to remove concepts that the user was not ready for. ISIS-Tutor was one of the first adaptive models to incorporate more than a bipolar knowledge model and one of the first adaptive systems to have empirical support for the effectiveness of adaptive interfaces [Brusilovsky and Pesin 1994]. The advent of the World-Wide Web, however, provided new opportunities for the development of adaptive hypermedia systems and led to new systems and more advanced adaptive techniques.

1.2 Second Generation Adaptive Hypermedia Systems

Second generation systems span the period from 1993 to present and predominantly use the WWW as their delivery and presentation means. These systems have worldwide availability and are generally platform independent. Second generation systems introduced new capabilities such as adaptive multimedia presentation, map adaptation, and link sorting. They also refined existing adaptation techniques to provide greater functionality. User models became more robust and incorporated more user characteristics. AHA [Bra 1996; Bra and Calvi 1998], ARNIE-HyperMan [Mathe and Chen 1994; Rabinowitz et al. 1995; Mathe and Chen 1996], AVANTI [Fink et al. 1997; Rizzo et al. 1997; Nill 1998], Basar [Thomas 1995], CS383 [Carver et al. 1996; Carver et al. 1996], Cameleon [Laroussi and Benahmed 1999], ELM-ART [Brusilovsky et al. 1996], I-Doc [Erdem and Johnson 1998; Erdem et al. 1998], InterBook [Brusilovsky and Eklund 1998] , KN-AHS [Kobsa et al. 1994], MediaDoc [Erdem et al. 1998], RATH [Hockemeyer et al. 1998] and WebWatcher [Armstrong et al. 1995] are examples of second generation adaptive hypermedia systems.

ELM-ART (The Episodic Learning Model: The Adaptive Remote Tutor) is good example of a second-generation adaptive hypermedia system. ELM-ART is a distributed intelligent tutoring system on LISP that provides course adaptation through a combination of adaptive annotation and link sorting [Brusilovsky et al. 1996]. Links are color-coded according to user preparation for the information in the node. Red annotations indicate nodes that the user has to meet the prerequisites for, amber nodes represent information the student is ready for but not recommended, and green nodes represent nodes that the user is ready for and are recommended. ELM-ART adaptively sorts links as well so that the links that are most similar to the node that the user is currently on are presented first.

ELM-ART features extensive user feedback and is highly interactive. As the user completes exercises and reads nodes, status bars change to reflect the user's progress through the course. Link annotations change color and the navigational view changes to reflect the user's newly gained knowledge. Users can directly edit the user model and override the navigational choices present to meet their educational goals. An extensive number of exercises engage the user and proved constant feedback both to the user and to the user model on the user's evaluated knowledge.

While second generation adaptive hypermedia systems such as ELM-ART have dramatically improved upon the functionality of first generation systems, there are fundamental flaws associated with these systems. These limitations include limited adaptation through one-dimensional, stereotypical user models, coarse granularity of adaptive support, closed adaptive hyperspaces with sharp boundaries, limited authoring support, and limited and non-constructive communications between the user and the adaptive model. The remainder of this paper will discuss these limitations with second-generation systems and propose framework for solutions.

2. Third Generation Adaptive Hypermedia Systems

2.1 Multidimensional User Models

Third generation adaptive hypermedia systems should support multidimensional user models. Current user models measure limited user characteristics to normally a single dimension such as declared or demonstrated knowledge, or hypermedia nodes visited. For example, AHA [Bra and Calvi 1998] uses the number of nodes visited while CS383 [Carver et al. 1996] consider learning styles as the basis for the user model. Actual users in a learning environment are much more complex and are both multi-dimensional and multi-faceted. Future user models must incorporate multiple dimensions of the user including expertise, user goals, interests, and preferred learning style by subject matter. These dimensions may be declared by the user, measured by the adaptive system, or combination of both approaches.

Not only must the user model incorporate multiple dimensions, the importance of an individual user model dimension may vary over time. As a user progresses through hyperspace, their goals and interests may change as they learn new concepts. The user model must quickly adapt to these changes in the user model so as to present relevant information to the user. Discrepancies between declared and demonstrated user characteristics must be resolved and presentation of material adapted. The users of adaptive hypermedia systems are not one-dimensional but instead are multidimensional. Future user models in adaptive hypermedia systems should be multidimensional and adaptive as well.

Providing adaptive, multidimensional user models raises a number of open research issues. Most current adaptive systems allow their users to explicitly manipulate the user model. This is most commonly done through a long list of checkboxes. Different presentation techniques will be required for users to effectively manipulate multiple user dimensions. The effective manipulation of a multidimensional user model clearly presents significant user interface issues. Additionally, it remains an open research issue as to what is the proper type and number of dimensions to measure. Adding additional dimensions will not always increase the accuracy of the user model but will always increase the complexity of the user model and the requirements to collect additional user information. There is a balance between the number of dimensions, model complexity, and the accuracy of the model. Finally, techniques for modifying the weights associated with different dimensions dynamically to better represent the user are open research issues.

2.2 Finely Grained, Multimedia Adaptation

Third generation adaptive hypermedia systems should provide a fine degree of adaptation granularity and adapt more than just hypertext. All second-generation adaptive hypermedia systems provide text-based adaptation based on a user model with limited levels of user differentiation. In addition to using multidimensional user models, third generation systems must incorporate multiple levels in each user model dimension so that the adaptation provided is truly tailored to the user. Users are not just novice, intermediate, or expert users but range a scale of many intermediate values. Users are not simply sequential or global learners but instead are some combination of both characteristics. Third generation adaptive hypermedia systems should not only model multiple dimensions of the user, but each dimension should have as much delineation as necessary to truly model the user.

In the last five years, there has been significant growth in the granularity of user models in adaptive systems such as ELM-ART [Brusilovsky et al. 1996], InterBook [Brusilovsky and Eklund 1998], AHA [Bra and Calvi 1998], and RATH [Hockemeyer et al. 1998]. These systems incorporate numerous exercises to capture more accurately user knowledge of hypermedia material covered. Third generation adaptive hypermedia must continue to build upon the successes of these earlier systems.

Third generation adaptive hypermedia systems should adapt more than hypertext. Adaptive hypermedia systems have traditionally focused on text presentation or navigation support. Only one system, CS383 [Carver et al. 1996] implemented adaptation of other media types such as sound, graphics, or video but its implementation was limited to adaptation of media type (not individual media elements) by learning style. Third generation systems must expand adaptation so that appropriate pictures, movies, slideshows, or sound files play to different users.

Introducing fine-grained multimedia adaptation raises a number of open research issues. Like adding additional dimensions to the user model, adding greater granularity to each dimension requires a much greater implementation effort and increases the complexity of the user model. Assessing the proper balance between granularity and adaptive system performance remains on open research issue. Multimedia adaptation adds additional complexity and requires a greater implementation effort. Media elements, other that text, are more difficult to generate and are not as malleable to automatic recombination. It is extremely difficult to automatically adapt video segments on the fly and present the results to users for example. Techniques for adaptation and presentation of media elements other than text are open research issues.

2.3 Open Adaptive Hypermedia Systems

Third generation adaptive hypermedia systems must support open adaptive systems. All known adaptive hypermedia systems, with the exception of Personal WebWatcher [Joachims et al. 1997], are closed navigation systems. Adaptation is provided while the user is in the restricted hyperspace of the adaptive system and there are explicit, well-defined navigational boundaries on the system. The adaptive system is self-contained. Because the system is self-contained, the author of the adaptive system must ensure that all information the user might require is inside the system. If users are not satisfied with the information resources within the system, they can either remain dissatisfied and use the adaptive system, or leave the system.

Third generation adaptive hypermedia systems should allow users to stay within the adaptive system but travel to informational resources outside of the navigational boundaries of the adaptive hyperspace. This tunneling through adaptive navigational boundaries provides the user the ability to gather additional informational resources and return to the adaptive system when ready. These informational resources may be links provided by the adaptive system to non-adaptive information resources outside the system that are constrained in a separate frame or in a new window, or may be a general-purpose search capability.

This ability to integrate external informational sources within the adaptive system provides a number of advantages that second generation adaptive hypermedia systems cannot. The informational resources of the adaptive system are significantly increased without a large amount of work by the adaptive system author. Users have greater flexibility to more deeply explore information within the conceptual model of the adaptive system and pursue individual goals and interests. But more importantly, based on the number of tunneling attempts outside the adaptive hyperspace by concept, the adaptive system gains a quantitative measure of informational regions within the navigational space that are not meeting user needs. Armed with critical feedback, the adaptive system author can then add new information to the system, remove useless information, provide additional external links to known information resources, or provide a general-purpose search engine. Future adaptive hypermedia systems should be open systems with soft boundaries as opposed to closed systems with hard limitations.

There are significant implications in the construction of open adaptive hypermedia systems. Adaptive hypermedia is no longer self-contained but instead is part of larger body of information. The synergistic integration of search engines and glossaries becomes important. Some second-generation hypermedia systems, such as InterBook [Brusilovsky and Eklund 1998], have already begun to include adaptive glossaries and several systems use extensive assessment to provide more accurate adaptation. As glossaries, digital libraries, search engines, assessment engines, and resources external to the adaptive system are added, third generation adaptive systems will be more of a solution and less of a research prototype.

Opening adaptive hypermedia systems to include informational resources outside of the navigational space of the adaptive system raises a number of interesting research issues. Capturing the tunneling activity and correctly categorizing it becomes an important research area. Are multiple, successive tunneling attempts indicative of a confused, frustrated user, a novice user exploring every link, or a happy, enthusiastic user that wants to leave everything they can about the subject matter at hand? Controlling the effects of context shift is another open research area. Even if the material is appropriate, it may be in a presentation style that causes the student to lose focus or become confused. Ensuring that users do not become lost when leaving the adaptive navigational space is likewise an open research issue. Finally, how to capture and react to user tunneling efforts is an open research issue.

2.4 Constructive Hypermedia

Third generation adaptive hypermedia systems should be constructive in nature. The most accurate user model is the one that users construct themselves. Users should have the capability to easily add material to the adaptive system with a clear delineation of material from the original author and from users. User should be able to view the original material only, all user comments, or their comments only. They should be able to add comments to pages as in the ELM-ART system [Brusilovsky et al. 1996] or annotate links, a technique which has not yet been implemented in an adaptive hypermedia system. Constructive hypermedia provides the most precise and fine-grained form of adaptation. As the complexity or size of adaptive hypermedia systems grows, so too will the need for constructive hypermedia.

There are a number of open research issues associated with constructive, adaptive hypermedia. User construction may be indicative that the underlying adaptive system is not meeting the information needs of the user. Mechanisms for evaluating user constructions and modifying the user model as necessary need to be explored and developed. Providing access to all user comments may not be productive and may confuse the user more than help them. Methods must be developed for assessing the impact and utility of user construction on the user and adapting the system appropriately. Further assessment of this approach is necessary before implementation.

2.5 Other Third Generation Attributes

2.5.1 Adaptation Feedback

Third generation adaptive hypermedia systems should provide better feedback to the user and better incorporation of user feedback into the user model. Users should easily be able to determine where they are, where they have been, what they have left to do, and what the user model is doing to them. In terms of adaptation, the user should be able to quickly understand the adaptation model and modify it to provide better adaptation. ELM-ART [Brusilovsky et al. 1996] is an example of a second-generation adaptive hypermedia system that provides excellent adaptation feedback. Additional work is necessary particularly in light of the multi-dimensional nature of the user model, to provide the user with clear feedback as to how user activities are influencing the adaptation.

2.5.2 Ease of Authoring

Third generation adaptive hypermedia systems must be easy to build and maintain. Most second-generation adaptive hypermedia systems are handcrafted and not easily expandable or adaptable to other projects. As adaptive hypermedia systems grow in size, dimensions, or the granularity of those dimensions, the ease of construction and maintenance of the systems will increase in importance.

2.5.3 Assessment of Effectiveness

Additional, statistically valid assessments of the effectiveness of adaptive hypermedia are necessary to validate the approaches that are effective and those that are not. Most assessments of second-generation systems were conducted with very small sample populations. Assessments of adaptive techniques, adaptive systems, and user models have begun but remain open research areas.

3. Conclusion

This paper has examined the development of adaptive hypermedia systems and proposed several attributes for third generation adaptive hypermedia systems. Third generation adaptive hypermedia systems must incorporate fine grained, multidimensional user models that support open, constructive, adaptive systems that are easy to build. Numerous research issues require resolution to provide these capabilities. Adaptive hypermedia systems have made great strides in the last fifteen years, but new capabilities and a better understanding of users and adaptive systems opens new avenues of research. Research into these issues raised by the advent of third generation adaptive hypermedia systems will bring us closer to realizing the full potential of adaptive hypermedia.

4. References

Armstrong, R., D. Freitag, T. Joachims and T. Mitchell (1995). *WebWatcher: A Learning Apprentice for the World Wide Web.* 1995 AAAI Spring Symposium on Information Gathering from Heterogeneous, Distributed Environments, Stanford, CA. Available at http://www.cs.cmu.edu/afs/cs.cmu.edu/project/theo-6/web-agent/www/project-home.html.

Bocker, H. D., H. Hohl and T. Schwab (1990). *Hypadapter - Individualizing Hypertext.* INTERACT 90, Amsterdam, Holland. 931-936.

Boyle, C. and A. O. Encarnacion (1994). MetaDoc: an Adaptive Hypertext Reading System. *User Modeling and User Adaptation* 4(1): 1-19.

Boyle, C. and S. H. Teh (1993). *Multimedia Intelligent Documentation: Metadoc V.* 11th Annual International Conference on Systems Documentation, Kitchener, Ontario, CA. 21-27.

Bra, P. D. (1996). *Teaching Hypertext and Hypermedia through the Web.* WEBNET 96 - World Conference of the Web Society, San Francisco, CA. 110-115.

Bra, P. D. and L. Calvi (1998). *AHA: a Generic Adaptive Hypermedia System.* 2nd Workshop on Adaptive Hypertext and Hypermedia, Pittsburgh, PA. 5-12.

Brusilovsky, P. (1992). Intelligent Tutor, Environment and Manual for Introductory Programming. *Educational and Training Technology International* 29(1): 26-34.

Brusilovsky, P. and J. Eklund (1998). A Study of User Model Based Link Annotation in Educational Hypermedia. *Journal of Universal Computer Science* 4(4): 429-448.

Brusilovsky, P. and L. Pesin (1994). *ISIS-Tutor: An Adaptive Hypertext Learning Environment*. Japanese-CIS Symposium in Knowledge-based Software, Tokyo. 83-87.

Brusilovsky, P. and L. Pesin (1994). *ISIS-Tutor: An Intelligent Learning Environment for CDS/ISIS Users*. CLCE. Available at http://cs.joensuu.fi/~mtuki/www_clce.270296/Contents.html.

Brusilovsky, P., E. Schwarz and G. Weber (1996). ELM-ART: An Intelligent Tutoring system on the World Wide Web. *Intelligent Tutoring Systems*. C. Frasson, G. Gauthier and A. Lesgold. Berlin, Springer Verlag. 1086: 261-269.

Carver, C. A., Jr., R. A. Howard and W. D. Lane (1996). *A Methodology for Active, Student-Controlled Leaning: Motivating Our Weakest Students*. 27th ACM Technical Symposium on Computer Science Education, Philadelphia, PA. 195-199.

Carver, C. A., Jr., R. A. Howard and E. Lavelle (1996). *Enhancing Student Learning by Incorporating Learning Styles into Adaptive Hypermedia*. EDMEDIA 96 - World Conference on Educational Multimedia and Hypermedia, Boston, MA. 118-123.

Erdem, A. and L. Johnson (1998). *Task Oriented Software Understanding*. Automated Software Engineering Conference. Available at http://www.isi.edu/isd/I-DOC/i-doc.html

Erdem, A., W. L. Johnson and S. Marsella (1998). User and Task Tailored Software Explanations. *Automated Software Engineering Journal*. Available at http://www.isi.edu/isd/erdem.html.

Fink, J., A. Kobsa and J. Schreck (1997). *Personalized Hypermedia Information Provision through Adaptive and Adaptable System features: User Modeling, Privacy and Security Issues*. Fourth International Conference on Intelligence in Services and Networks, Como. Italy. Available at http://zeus.gmd.de/hci/projects/avanti/publications/ISandN97/ISandN.html.

Hockemeyer, C., T. Held and D. Albert (1998). *RATH: A Relational Adaptive Tutoring Hypertext WWW - Environment Based on Knowledge Space Theory*. Proceedings of the Fourth International Conference CALISCE 1998, Goteborg, Sweden. 417-423.

Joachims, T., D. Freitag and T. Mitchell (1997). *WebWatcher: A Tour Guide for the World Wide Web*. International Joint Conference on Artificial Intelligence. Available at http://lia.univ-savoie.fr/~bleyer/agent/references.html.

Kobsa, A., D. Müller and A. Nill (1994). *KN-AHS: An Adaptive Hypertext Client of the User Modeling System BGP-MS*. Fourth International Conference on User Modeling, Hyannis, MA. 99-105.

Laroussi, M. and M. Benahmed (1999). *CAMELEON: Computer Aided MEdium for LEarning On Networks*. Available at http://lithwww.epfl.ch/~laroussi/cameleon.html. Accessed on February 20, 1999.

Mathe, N. and J. R. Chen (1994). *A User-Centered Approach to Adaptive Hypertext based on Information Relevance Model*. 4th International Conference on User Modeling, Hyannis, MA. 107-114.

Mathe, N. and J. R. Chen (1996). User-Centered Indexing for Adaptive Information Access. *International Journal of User Modeling and User Adapted Interaction* 62(2/3): 225-261.

Nill, A. (1998). *AVANTI Home Page*. Available at http://zeus.gmd.de/hci/projects/avanti/cd-rom/contents/contents/index.htm. Accessed on February 25, 1999.

Rabinowitz, J. L., N. Mathe and J. R. Chen (1995). *Adaptive HyperMan: A Customizable Hypertext System for Reference Manuals*. AAAI Fall Symposium on Artificial Intelligence Applications in Knowledge Navigation and Retrieval, Cambridge, MA. Available at http://ic-www.arc.nasa.gov/ic/projects/aim/cid/cid.html.

Rizzo, A., E. Marchigiani and A. Andreais (1997). *The AVANTI project: prototyping and evaluation with a cognitive walkthrough based on the Norman's model of action*. ACM Conference on Designing Interactive Systems. 305-309.

Rosis, F. D., B. D. Carolis and S. Pizzutilo (1994). *User-Tailored Hypermedia Explanations*. Workshop Adaptive Hypertext and Hypermedia at 4th International Conference on User Modeling, Hyannis, MA. Available at http://www.education.uts.edu.au/projects/ah/deRosis.html.

Thomas, C. G. (1995). Basar: A framework for integrating agents in the World Wide Web. *IEEE Computer* 28(5): 84-86.

Is the web the best hypertext structure we have?

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Abstract

We present a research concerning the best way of structuring educational content on the Web. Our belief is that both the organization of the nodes and the cognitive capabilities of subjects deeply influence the learning process. We built a test with three versions of the same lesson, submitted to three groups of university students: a paper version, a hierarchical version, and a networked version. Having evaluated the cognitive capabilities of the subjects, having looked analytically at their behaviors in the navigation, and finally having measured a "learning" score, we found that the worst performance was obtained by the group that used the networked hypertext. Moreover, the best was not the "paper" group, but the group facing with the hierarchical structure. The claimed educational effectiveness of the WWW seems to be a misconception, to be further analyzed, and probably the Web should be reconsidered only as an extraordinary mechanism for distributing information.

Introduction

In this paper we present the latest results of our long-term research on the problems arising in the learning processes mediated by the hypertext technology, with particular attention to the "lost in hyperspace" phenomenon [Castelli et al., 1991], [Castelli et al. 1997]. Our latest benchmark led us to significant but surprising considerations. We submitted three versions of the same lesson to university students: a paper (sequential) version, a hypertext with a hierarchical organization (tree) and a networked (graph) structure. One interesting indication regards the worst performance obtained by the group that learned from the networked hypertext. Looking at the current studies, these are not completely surprising indications. People like us, who privileged the "web" structure for their educational hypertexts, also on the WWW, are facing with "change of minds". The Web created a tangled network of links in which the "lost in hyperspace" phenomenon is more likely to happen. Many palliatives have been proposed or developed, like backtracking mechanisms, conceptual maps, etc., but in our opinion, the problem is elsewhere.

As with all new fascinating techniques, hypertexts have attracted many people dealing with information, both having to transmit information to others (as teachers) and having to organize information to build information, like researchers, media experts, commercial enterprises etc. However, the same "web" metaphor is not extensible to both the target audiences. For example, the vanguard literature [Landow 1992] immediately felt attraction towards the idea of creating links among text, and teachers found the hypertext a stimulating perspective for creating educational material with the target of creating Open Hypermedia Systems (OHS). The problem is that the student has not the same knowledge of the teacher. This "distance" between them is one of the first recognized reasons of disorientation in hypertext, and it becomes more evident when we navigate through the World Wide Web. Authors build "a priori" conceptual spaces for students they will never meet, without knowing their background, humor, preferences, cognitive capabilities, sex, mental strategies in facing with educational material, etc.

Obviously we are not denying the potential of the WWW as an educational media, but we believe that we all confused the tool with the underlying metaphor, and have applied the metaphor (the web, the network) to everything put on the WWW. Another misconception regards the claimed educational effectiveness of hypertexts (and the Web as a consequence), effectiveness that should be due to the isomorphic relation between the hypertext and the human brain, or between the hypertext and the way we organize thought in our mind [McKendree et al, 1995]. Applying the network organization to the nodes of an educational hypertext seems to lead to unsatisfactory results, in terms of learning, and the experiment presented in this paper confirms this impression.

2. The World Wide Web: is it suited for learning?

"Lost in Hyperspace" is an old issue in the HT research, and surely one of the most difficult to solve by the hypertext / hypermedia community. Since Conklin's cornerstone survey [Conklin 1987] through other specific studies [Edward et al. 89], in every conference or book related with hypertext, disorientation, cognitive overhead, "lost in hyperspace" are crucial problems [Campagnoni et al.,1989]; [Kibby et al.,1989]; [Bernstein,1990]; [Boyle et al.,1990]; [McAleese,1989], [Jonassen,1990]; [Nielsen, 1990]; [Gay et al. , 1991]; [Tricot, 1993].

There are, however, different ideas to solve it. The first solution is, in reality, a non-solution: "lost in hyperspace" and its negative influence on learning processes do not exist, or they are only marginal problems. According to this, efforts should be channeled to address more interesting and urgent issues - conventional 'human factors', quality of design, response times of the Web etc. [Kellogg & Richards, 1995]. With the advent of the Web, its nature of immense hypertext convinced us that, on the contrary, a further effort must be devoted to the solution of this problem. Many teachers are putting their educational materials on the web, so a new "distributed" way of learning is rising. The implications of the disorientation phenomenon is particularly evident when we try to learn something, but are not so evident (or crucial) in other activities on the Web. For example, while searching for a new airplane rate, it doesn't really matter if we get lost. With the tools supplied by the browsers (back, previous, history etc.), we can gain the control of the context and start the search again. Nevertheless, if we are learning from web pages, the situation is different. Getting lost is not only a matter of minutes spent to understand where we are in the Web pages, but mostly means to locate ourselves in the learning context, and this is a more delicate issue.

From this perspective, the WWW is a less controllable hypertext with respect to the ones created with hypermedia systems. Many authoring tools, in fact, have a local approach, pages are confined inside the conceptual space that the teacher proposes, and this greatly limits the chances of "getting lost". Moreover, authoring tools use simple programming languages that allow "enterprising" teachers to develop navigational aids to overcome orientation problems. HTML editors have greatly facilitated the creation of web pages, but in our opinion this has lowered the level of carefulness devoted to the navigational structure of the hypertext. Very often, we see educational hypertexts with the navigation mechanisms confined to "next", "previous", "back", "go to index". This is probably enough for a non-disoriented user, but is surely not enough for a possible disoriented, bored, or novice user. In addition, the tracking mechanism is more complex on the Web, and most of all is out of the direct management of the teacher. Tracking users' interactions with the HT is very important, as the teacher can understand the difficulties of the users, where the structure should be simplified, where to add or remove content, etc. In conclusion, if the Web and the HTML language have favored the distribution of educational material, they have reduced on the other hand the possibilities of improving the effectiveness of hypertext technology as a learning medium.

The most frequent reason of learning problems with hypertexts, disorientation, is also amplified by the WWW. Many researchers are studying this problem as a problem generated (and therefore solvable) during the design phase by the author. The rationale is: a coherent and well-structured hypertext should reduce disorientation. Based on this idea we can find many approaches: [Garzotto et al.,1993], [Lange,1994], [Schwabe,1995], [Isakowitz et al. , 1995] are only some examples, while recently many authors are trying to investigate the specific problem on the Web [Brown et al. , 1996] [Svensson et al.,1998]. Following this approach, the most common solutions are:

- predefined paths inserted in the HT, sometimes called trails, guided tours, hypertours etc. [Nicol et al., 1995].
- Providing the hypertext with conceptual and/or graphical maps, both local and global, or other visual aids like fish-eyes views, bird-eyes, zoom viewers etc.
- Providing users' profiling, i.e., creating (before or during the navigation) a set of her/his navigation preferences on the basis of various criteria, to be used for subsequent navigations;
- user is provided on the fly with sorts of "balloon help" regarding what is available and what to do next.

All these tools are valuable and useful, but in our opinion they are too oriented on the author's side. This, in some sense, has a bad effect on the author,i.e., less attention in structuring the HT. In our opinion, we can't improve the way people learn from hypertexts ignoring the problem of disorientation. Not only we have problems related with the structure of a hypertext [Thimbleby 1995], but we also have cognitive problems regarding the performances users provide while reading a hypertext. We believe that the learning process through the hypertext technology deserves a major attention on these two decisive aspects, i.e., the structural aspects of the hypertext and the cognitive capabilities of the users. There is the basis of our experiment presented in this paper.

3. The experiment

The structure of the experiment is quite consolidated: we learned that user's performance on a educational HT is greatly affected by a set of factors, the major of which are in short the following: the influence of some cognitive variables on the subject's performance (like intellectual efficiency, analytical ability, analytical flexibility, synthetic ability, abstract reasoning, cognitive field independence), the presence of a graphical interface, the time of browsing, the differences in performance between males and females, the presence of "loops" on certain nodes and, last but not least, the hypertext structure. We started from most relevant results presented in [Castelli et al, 1997]:

- subjects showed a relevant tendency to use serial mechanisms in "browsing" pages as "a default novice navigation" strategy, thus resembling the traditional approach to text material;
- subjects also showed a tendency to concentrate on information that they associated on the base of a sort of similarity among information, with a partial but preferential use of the hierarchical structure. The preferred structured seemed to be a sort of "cluster" model, consisting of a partially hierarchical framework with branches radiating out to information nuclei aggregated by similarity (by content or by class).

From these considerations, the experiment tried to understand the relation between the level of learning and two other aspects, respectively the cognitive capabilities of subjects and the structure a hypertext. We structured the whole experiments in three steps: (1) making a cognitive profile of the users; (2) submitting the educational material and recording the navigation; (3) evaluating the level of knowledge reached by the users through a questionnaire. Step 1 has been used both to create similar groups and to find relationships between cognitive attitudes and hypertext performances. As regard as the cognitive performances, we submitted the cognitive test called *Raven's Progressive Matrix* (**PM**) [Raven, 1987], that consists of a series of problematic situations, which, in progression, involve various intellectual processes. Regarding the second step, the structure is the one we firstly experimented in [Castelli et al., 1991], and that has been used in other experiments [Gomes, 1997]: the user reads the hypertext and a hidden program writes on a log files every moves s/he makes with a series of parameters (node id, time on the node, type of node etc.). Based on the target of the research, additional parameters are added to the log files, and the analysis is conducted matching expected behavior with real behavior of the user on the hypertext. We built two hypertextualized versions of the same paper material, and submitted these two together with the original paper document to three groups of university students. The common task was responding to some questions of a new argument of the course of General Psychology. Students never heard about the topic, a lecture covering a specific argument (Gestalt psychology). The three groups were organized as following:

- one group was given the paper version (we will identify it as the "text" group);
- one group worked on one electronic version with a hierarchical overstructure: the first page of the HT was a tree of the arguments to provide a conceptual and hierarchical map of the topics of the lecture ("tree" group);
- one group with an electronic version structured as a networked set of pages linked together ("graph" group).

The third stage of the experiment was at the end of the time left for learning: a 30-question test was submitted to the students, in order to evaluate the quality of the learning process. The subjects worked on the educational material equally for all the three groups, for about ninety minutes. After an interval of 30 minutes, they faced with the questionnaire, in which the right answer for each question had to be chosen from a list of four.

4. Discussion of the results

[Tab 1] gives the results of the subjects on the cognitive test (PM) and on the learning test (LT), distinct in the three experimental conditions: "Graph ", "Text " and "Tree". The subjects are identified by the numbers originally assigned to them, with a letter (G for graph, N for normal text, T for tree). [Tab 1] sets out, in order, the raw scores (PM, LT) and centil transformation of LT scores (%LT). The PM scores are yet expressed in centils.

	"Graph" subjects						"Text" subjects					"Tree" subjects					
	g10	**g13**	**g14**	**g15**	**g16**	**g23**	**n01**	**N02**	**n08**	**n09**	**n17**	**t05**	**t06**	**t07**	**t20**	**t21**	**t22**
PM	68	44	44	75	7	65	49	56	61	57	61	64	61	56	35	63	40
LT	15	8	9	15	14	13	17	18	11	22	19	19	22	8	14	22	15
% LT	50	27	30	50	47	43	57	60	37	73	63	63	73	27	47	73	50

Table 1 – Score on Cognitive and Learning Test

For the subjects who used the hypertext, [Tab 2] presents some indexes for evaluation of the navigation performance. The indexes are derived from processing the navigation raw data, and are mainly concerned with:

- *number of moves*, distinguishing between "navigation moves" and "pages of text" moves;
- *time* spent on a *node*, again distinguishing between navigation nodes and "pages of text" nodes;
- *repeated visits* to a node
- *difference between* the amount of *time* spent by the subject on a node and "*author time*", i.e. the time assessed by the author as required to grasp the meaning of the node.

SS	TMV	TT	% RP	% MM	% NM	% HM	% RV	RT-	RT±	RT+
g10	234	5536	85%	34%	66%	21%	55%	15	27	24
g13	130	5432	72%	31%	69%	31%	41%	14	9	32
g14	95	5421	63%	28%	72%	32%	24%	6	12	28
g15	144	5429	88%	43%	57%	1%	42%	0	40	29
g16	243	5427	99%	44%	56%	0%	51%	18	52	10
g23	193	5483	69%	26%	74%	36%	53%	14	23	15
t05	264	5277	96%	47%	53%		24%	25	36	17
t06	231	5405	100%	45%	55%		19%	37	36	9
t07	223	5413	99%	46%	54%		17%	18	47	16
t20	163	6136	97%	46%	54%		6%	14	28	36
t21	198	5361	99%	43%	57%		16%	16	44	21
t22	393	5394	100%	42%	58%		37%	46	21	15

Table 2 –Some indices of hypertext performance

The meaning of the columns in [Tab 2] are the following [Tab 3]:

TMV	Total number of Moves;
TT	Total Time (in seconds) of navigation in the hypertext
%RP	percentage of read text Pages
%MM	percentage of Map Moves
% NM	percentage of Nodes Moves (the sum of: returns to map + multiple pages moves + hotword moves);
%HM	percentage of Hotword Moves; this index is valid only for the graph version of the hypertext, as there were no hotword in the tree version
%RV	percentage of Return to Visited nodes on total moves, excluding the map returns;
AT-	number of pages read with at least 30% of seconds less than the Author Time;

AT±	number of pages read within a ±30% of seconds of Author Time
AT+	number of pages read with at least 30% of seconds more than the Author Time.

Table 3: meaning of columns in [Tab 2]

The first interesting result comes from the learning test ([Tab1] and [Fig 1]), in relation with the type of material used. We see a better global performance of the "tree" subjects with respect to the "graph" group, with the "text" group similar to the "tree" group. Considering the cognitive capabilities obtained ([Tab 1] and [Fig 2]), this result has a particular meaning. In fact, the three groups had similar cognitive capabilities, with a slight predominance of the "text" group. Since the groups were limited, in order to verify the consistency of our results, we carried out two kinds of statistical analysis to verify the following:

1. are the score obtained in the three conditions so different to create three different samples?
2. Are these differences real or are they induced by the different cognitive capabilities of the samples?

For the first issue, we used the *Montecarlo Method* (with a random draw of 10.000 samples): the evidence of the difference in the groups has not been obtained with the mean (only a probability of 12% that the "tree" and "graph" groups were independent), but with the median (the probability of independence of the two groups raises at 97%). This difference seems to be related to the presence of one subject in each group who had a very low score: the median "shades" the effects of these marginal subjects.

For the second issue, we used a linear regression test on the *Learning Test* and the *Cognitive Test*. From this we deduced that, with the same score at the *CT*, the three situations are different, while the "text" and the "tree" have the same influence on the *LT*, the difference between "tree" and "graph" in influencing the *LT* is significant at the level of $p = .10$. From these data, we can infer the following general considerations.

1. "tree" structure facilitates context control, with a sequential approach resembling the reading of a book;
2. "tree" perform better than "graph", and this could be due to the time spent in organizing the access to the structure. This time absorbed many resources of the "graph" subjects to dominate the HT structure. The hierarchic structure, instead, is already an indication on the organization. This explanation could be supported by the navigational data, that show: a) many "returns" of the "graph" group to nodes already seen ([Tab 2], column **%RV**) b) in general, an inferior number of moves with respect to the "tree" group (column **TMV**);
3. Sequence and hierarchy of the "tree" HT resemble the traditional text, where a "passive" reading strategy is generally required. Based on our analysis, we can imagine that subjects with less cognitive capabilities were helped by and took advantage from the hierarchical structure during the navigation;
4. A variable related with the final score *LT* is the time subjects stop on the "map" pages. The worst *LT* subjects are exactly the ones who present the highest peaks and average of time of stop on the map. We can hypothesize only the following, as our data are not sufficient: users have different targets. Subjects with high performances use the map shortly to carry out the next move, because they have already a strategy to follow. Subjects with low performances use the permanence on the map right to develop a strategy because, we can imagine, they do not have a strategy yet and they lose time to develop it.

These considerations could be deepened looking at the individual performances in the two groups. [Fig 3] presents the values of the progressive matrix **PM** and the Learning test **LT**, with respect to the top possible performance.

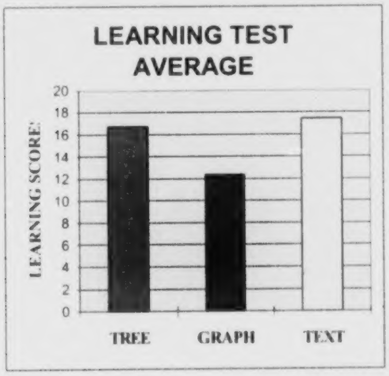

Fig 1 – Learning test average for 3 groups

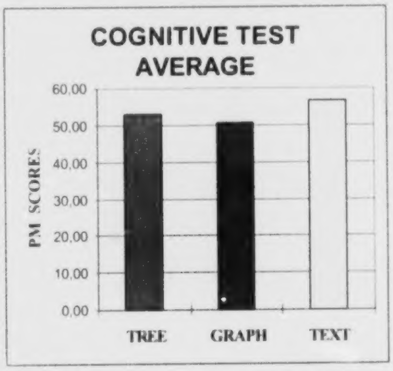

Fig 2 – Cognitive test average for 3 groups

We can see immediately the different trends in the two groups:

- The "*graph*" group has a **PM** score higher than the LT score, except subject **g16** that has the opposite trend;
- The "*tree*" group has the LT score higher than the **PM** score, except the subject **g16** that has the opposite trend;
- The "*text*" subjects have minor differences between the scores, except **n08** (higher PM) and **n09** (higher **LT**).

The differences in the two trends seem to confirm the above considerations:

a) Having the same cognitive capabilities (**PM** score), the tree structure facilitates the browsing and the study of the material, allowing a more "efficient" access to information and a better attention to the content;
b) Considering the % of the information read, (column **%RP** of [Tab 2]; the average of %RP is **98.5** for "tree" and **79.3** for "graph") the significant difference underlines the different result at the Learning Test ([Fig 1])

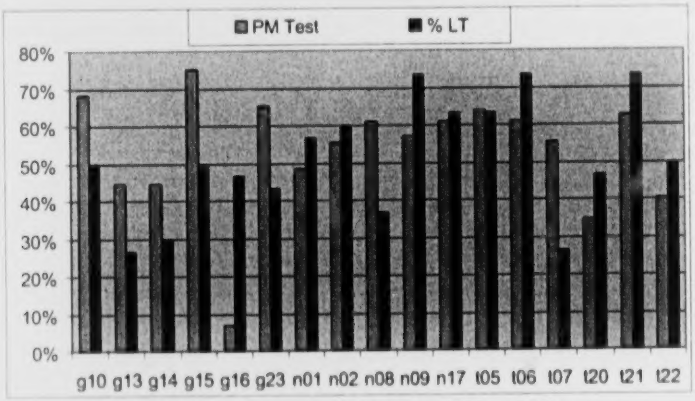

Fig 3 – Individual comparison between PM and LT scores

In conclusion, we looked move by move to the performance of the "foreign" subjects for the two groups, **g16** e **t07**. G16 has adopted a clear strategy of browsing the nodes, equal to the "tree" subjects, i.e., repeatedly going back to the map without using the hotwords. G16 used the graph HT as it was a hierarchy (column **%HM** of [Tab 2] with value 0%). The interesting aspect is that with this "Tree" strategy applied on a graph, the subject had one of the best performances of his/her group, in spite of a low cognitive score. This could enforce the previously mentioned idea that subjects with low cognitive capabilities had better perform on a hypertext with a prevalent hierarchical structure. The other "atypical" subject (t07) is most difficult to interpret. We note that: a) the time of reading (**RT-**, **RT±**, **RT+** of [Tab 2]) was very frequently tightly aligned with the author time; b) on pages that were important for the solution he/she had short time of permanence (2 or 3 seconds). It must be noted that the "author time" is only sufficient for reading the page, probably not enough for learning its content, and sometimes could indicate an erroneous evaluation of the importance of the page. All these reasons can justify, in our opinion, the bad performance on the learning test.

Conclusion and future directions

We presented the results of a research on problems related with learning processes in the Web educational material. We noted that the network metaphor used to organize educational material is not so suited for everyone. First evidences shows that networked information is good for people that already know the corpus, while people facing with new arguments and/or having less brilliant cognitive capabilities perform better in presence of hierarchical material. In our tests, they evidently had a better management of the hypertext, of its structure, they optimized movement on the hypertext's nodes and took benefit of the time at their disposal because not caught in understanding and mastering the net. These preliminary results lead us to reconsider the role of networked hypertexts in the computer-mediated learning processes. We also obtained other indications concerning the role of the cognitive abilities in the hypertext reading. First, we noted that, having the same capabilities, subjects perform better with a hierarchical hypertext. Second, people with less cognitive capabilities seem to prefer the hierarchical organization of the hypertext as it supplies a more "oriented" navigation.

There was another objective in the experiment, related with the previous one: the influence of possible disorientation problems on the learning performance, with the indication of the variables that facilitate or reduce the onset of this phenomenon. Our data don't allow us any type of conclusion, because the indexes obtainable from the recorded moves have no unique interpretation. For example, the index that outlines the returns on pages that were already visited could indicate a disorientation state: the user didn't remember to have already visited it, or the user erroneously interpreted the previous link. However, as the target for the subject was to understand and "learn" the content of the hypertext, it was hard to distinguish these different kind of "returns": a) the subject wanted to deepen the page b) the subject wanted to read again a concept found in other pages c) the subject wanted to complete a previously incomplete reading of the page. On the other hand, the above elements can be partly indicative of the presence of a situation of disorientation, or at least representative of an objective difficulty in managing the context that could lead to "getting lost in hyperspace".

In conclusion, the World Wide Web is surely a great step toward the visionary idea of Nelson and his Memex: all information from all the world linked together thanks to an immense hypertext. However, the intrinsic networked structure of the web and the absence of specific aids for navigating are, in our opinion, a problem that challenges the effectiveness of educational hypertexts on the WWW. We therefore believe that further studies are needed in order to understand how to maximize the learning process from hypertextual materials. We are moving in this direction with another series of fine-tuned experiments:

1. Testing groups of subjects with different cognitive capabilities but using the same hypertext;
2. Learning scores in presence of diversified hypertextual structures: "tree-based" hypertexts with hotwords, "graph-based" hypertext with nucleus of nodes hierarchically organized. This mixed structures better describe the situation of hypertexts currently present on the WWW;
3. testing other cognitive variables that could lead to a better definition of the relationship between cognitive abilities and learning processes, in particular the role of working memory

REFERENCES

[Bennet, 1959] Bennet G.K., Seashore H.G., Wesman A.G., DAT Differential Aptitude Tests., OO.SS., Firenze, 1959.

[Bernstein, 1990]. Bernstein, M. (1990) "The Navigation Problem Reconsidered", in Hypertext/Hypermedia Handbook.Emily Berk & Joseph Devlin (editors), Software Engenieering Series, Intertext Publications, Mc Graw Hill Inc., 285-297.

[Brown et al., 1996] Brown, C. and Benford, S. (1996). Tracking WWW Users: Experience From the Design of Hy-perVisVR. Proc. WebNet '96, AACE, San Francisco, CA, 57-63.

[Boyle et al., 1990]. Boyle, C.D.B. & Snell, J.R. (1990). "Intelligent navigation for semistructured hypertext documents", in McAleese, R & Green, C. (editors); Hypertext: state of the art. Oxford, Intellect Limited.

[Campagnoni et al., 1989]. Campagnoni, F.R. & Ehrlich, Kate (1989). "Information Retrieval using a Hypertext-Based Help System", ACM Transactions on Information Systems, vol.7, n.3, 271-291.

[Castelli et al, 1991] Castelli, C.; Colazzo, L.; Mich, L. & Molinari, A. (1991). "Tests & hyperTexts: the HT_DEDALUS Project", in Education in Computing - Newsletter, vol.3, n.2 (May-August), 65-74.

[Castelli et al., 1997], Castelli C., Colazzo L., Molinari A., Cognitive variables and patterns of hypertext performances:lessons learned for educational hypermedia construction, Journal of Educational Multimedia and Hypermedia, AACE-Association for the Advancement of Computing in Education, USA

[Conklin, 1987], "Hypertext : An Introduction and Survey," IEEE Computer, 2(9), pp17-41.

[Edwards et al., 1989] Edwards, D.M. & Hardman, L., (1989). Lost in Hyperspace: Cognitive Mapping Navigation in a Hypertext Environment. In McAleese, R., (Ed.), Hypertext: theory into practice. Norwood, N.J.: Ablex Publishing Company.

[Garzotto et al., 1993] Garzotto, F.; Paolini, P.; Schwabe, D. (1993). HDM - A Model Based Approach to Hypermedia Application Design. ACM Transactions on Office Information Systems, 11 (1), 1-26.

[Gay et al., 1991]. Gay,G. & Mazur, J. (1991). "Navigation in Hypermedia", in Emily Berk & Joseph Devlin(editors). Hypertext/Hypermedia Handbook. Software Engenieering Series, Intertext Publications, Mc Graw Hill Inc..

[Gomes 1997], Gomes M.(1997), A Quantitative Approach to Navigation Paths and Behaviour of Inexperienced Users of Hypermedia Documents, ED-MEDIA 97, Conference on Educational Multimedia & Hypermedia, Calgary, Canada, 569-575

[Isakowitz et al., 1995] Isakowitz, T.; Stohr, E.; Balasubramanian, P. (1995). RMM: A Methodology for Structured Hypermedia Design. Communications of the ACM, 38 (8), 34-44.

[Jonassen, 1990]. Jonassen, D. (1990). "Semantic network elicitation: tools for struturing hypertext", in McAleese, R & Green, C. (editors); Hypertext: state of the art. Oxford, Intellect Limited.

[Kellogg et al.,1995], "The human factors of information on the Internet," in Advances in Human-Computer Interaction, V, ed. Nielsen, J., Academic Press, pp1-36.

[Kibby et al., 1989]. Kibby, M.R., Mayes J.T. (1989). Towards Intelligent Hypertext, Educational Tecnhology, vol.31 n.1, 15-20.

[Landow 1992] George P. Landow, HYPERTEXT the convergence of the contemporary critical theory and technology, The Johns Hopkins University Press 1992

[Lange 1994]. Lange, D. (1994). An Object-Oriented Design Method for Hypermedia Information Systems. InternationalConference on System Sciences, 1994, Maui, Hawaii. 1994. 366-375.

[McAleese 1989]. McAleese, R.; (1989). "Navigation and Browsing in hypertext" in McAleese, R. & Green, C. (editors) Hypertext: Theory into Pratice. Oxford, Intellect Limited, 1-5.

[McKendree et al, 1995] McKendree, Reader and Hammon (1995). The Homeopathic Fallacy in Learning from Hypertext, Interactions July,1995., pp. 75-82.

[Nicol et al., 1995] Nicol, D., Smeaton, C., & Slater, A. (1995). Footsteps: Trail-blazing the Web. Proceedings of the 3rd International Conference on the World Wide Web. Darmstadt, Germany. http://www.orbital.co.uk/orbital/www4.html.

[Nielsen, 1990]. Nielsen, J. (1990). Hypertext & Hypermedia. Academic Press, Inc., Harcourt Brace Jovanovich, Publishers, 223.

[Raven, 1987] Raven J.C., Progressive Matrici. Serie I e II, OO.SS., Florence, Italy, 1987.

[Schwabe, 1994] Schwabe, D.; Barbosa, S. (1991). Navigation Modeling in Hypermedia Applications. Technical Report, PUC-RJ, Brazil, 1994.

[Schwabe, 1995] Schwabe, D.; Rossi, G. (1995). Building Hypermedia Applications as Navigational Views of InformationModels. International Conference on System Sciences, 1995, Maui, Hawaii. 231-240.

[Svensson et al., 1998]. Svensson M., Johansson A., Ereback A., Höök K., Karlgren J. (1998), Moving Usability Testing Onto the Web, Proc. WebNet '98, AACE, Orlando, Fl.

[Thimleby, 1995]. Thimbleby, H. (1995), Authoring consistent hypermedia without getting lost, HCI'95 Adjunct Proceedings, pp118-124.

[Tricot, 1993]. Tricot, A. (1993). "Stratégies de Navigation et Stratégies d'Apprentissages", in Actes des 2èmes Journées Francophones "Hypermedias et Apprentissages", Lille - France.

[Witkin, 1971] Witkin H., Oltman P.K., Raskin E., Karp S.E., A manual for the Embedded Figure Tests, Consulting Psychologists Press, Palo Alto, Ca, 1971.

Beyond Chat - New Generation Software for Real-time Discussion

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Abstract: The use of chatrooms as a forum for discussion is increasing in popularity. Consequently there is a need for generic software to be designed which is readily configurable to the requirements of particular domains and which is also extensible. This paper discusses the design requirements of such a system and presents a novel chatroom generation system, ChatterBox, implemented in Java.

1. Introduction

Since the invention of the WWW there has been an explosion of interest in the use of technology, in education. Much of this interest has focussed on the WWW as a vehicle through which to present information to students. Increasingly however, it has been recognised that in order to maximise the value of the infrastructure provided by the WWW in the service of education, *greater interactivity* is needed. On the one hand software is required that facilitates the engagement of the student with the education material and can be readily integrated into the infrastructure provided by the Web. An example of such software would be on-line simulations [Neilson et al 1996]. On the other hand, appropriate communications technology is required to support discussion about the educational material. Educational content requires to be reflected upon and debated if deep learning is to occur [Laurillard, 1993]. The focus of this paper is on communications technology.

The main forms of communications technology readily available on the Internet are email, newsgroups and chatrooms. Both email discussion lists and newsgroup technology such as Hypernews are widely recognised as educationally useful tools [McKendree and Mayes, 1997]. Chatroom technology by contrast has generally been regarded as a somewhat frivolous application. Traditionally, chatroom use has been viewed as a purely recreational activity, something that is done for fun, an opportunity to discuss a hobby with like-minded individuals. Increasingly, however, the potential educational value of chatroom technology is being recognised. Chatrooms may be used to promote learning by providing a forum for critical dialogue on a topic between peers. Chatrooms have the advantage over email of allowing multi-user discussion in real-time. They more realistically support the dynamics of traditional classroom based educational debate in the on-line environment. As societies increasingly promote distance education opportunities and the need to acquire new skills throughout a person's working life, the use of chatrooms as forums for discussion will undoubtedly increase. Large businesses might be expected to provide such facilities as part of the training provision made for a workforce to update their skills or indeed as part of an on-line customer support environment. Chatrooms can thus potentially serve a wide variety of useful commercial and educational as well as recreational purposes.

The disparate nature of the contexts in which chatrooms can be employed, requires that the technology used for chatroom generation be highly configurable to the requirements of a particular context of application. Chatrooms employed in a distance learning context can require a *differentiation of user privileges* between a instructor and a learner that does not apply in the chatroom of a football supporters' WWW site. Often one wishes to *restrict access* to the former but not to the latter type of chatroom. Where chatrooms are open to anyone there must however by a system for *regulating the number of users* who are on-line simultaneously in order to prevent server overload[1]. In some chatrooms, it may be desirous for regular users of a chatroom, such as loyal customers or senior students, *to be afforded special privileges* or for certain users, such as an instructors, to be able to *reserve a username* for their use only. In many, though not all, chatroom disruptive users can be a problem. It is thus often desirable for selected individuals to have *policing rights* in particular chatroom contexts in addition to the system being capable of *automatically monitoring* and *controlling* anti-social behaviour such as abusive language. In a learning context an individual may wish to hide their ignorance about a topic by communicating only with a trusted friend or with the tutor. There is thus a need of an *option for one to one conversation*, (referred to in this paper by the term *whispering*), that does not perhaps apply so much in a recreational context. There may also be a need for a chatroom to have *filtering capabilities* so that an individual can selectively chose not to receive messages from other users who are found to be irritating- for example fans from a rival football team in a sports'chatroom.

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[1] Controlling the load on the server computer is particularly important where Java applets are involved. Security restrictions on applets forbid connection to servers other than that from which the Java classes were served. The chat server thus needs to live on the same machine as the web server.

Generic software for chatroom generation also requires to be readily extensible. Most chatroom generation software is based on the client/server model. Increasingly it is implemented in Java with the server residing on the same machine as the WWW server and the client taking the form of an applet embedded in an HTML document[2]. Applets are however also increasingly used to extend the functionality of a WWW site. There is thus a need for chat client applets to be able to communicate with other applets on a WWW site in order to increase the 'interactivity' of the host WWW site. This point is best illustrated by an example. We developed a football commentator system, http://anfield.merseyworld.com/commentary/, which allowed details of live football matches of a the Liverpool football team to be broadcast around the world over the WWW along with text transcripts of a game 'as it happened'. This commentator system employed Java applets client side. Our webmaster wanted the transcripts of the match to be fed into the Liverpool football club's supporters' chat room, http://anfield.merseyworld.com/chat/detach.html, in order that supporters could see the commentary of a current match as part of the chat. A special interface had to be built to allow the commentary system applet to pipe its output into the chat system applet. A more generic solution than this is desirable.

Finally, many generic chat systems fail to adequately support the use of colour in their interface. Support for coloured text in the chat area would not only brighten the interface but would also be functionally useful. Colour coding can provide a visible means of filtering fast moving discussion and distinguishing between different types of message. Utilisation of icon buttons (instead of AWT text only buttons) would also help to customise the look-n-feel of the chat applet to a particular application context. Finally as Web Sites are frequently quoted in on-line discussions, any URLs within a user's message text should be clickable and operate in a similar fashion to web page hyperlinks.

This paper presents a Java based client/server system for chatroom generation, ChatterBox, which is both configurable and extensible and includes the aforementioned interface features.

2. The architecture of ChatterBox

2.1 The basic client/server system

ChatterBox is a generic system for chatroom generation written in Java. It employs a client/server architecture. However, while in many chat systems server side processing dominates this is not the case with ChatterBox. In ChatterBox, only essential filtering such as that required for security is conducted server side. Conducting filtering client side, as for example through the plug-in system we describe, has the advantage of allowing client systems with vastly different filtering requirements to co-exist on the one server without fear of incompatibility. The robustness of the Java server was tested using a simulated client which waits a random time before starting, then repeatedly connects/disconnects at random intervals, sending a random number of messages each time of a random length at random time intervals. This test client was designed to try to approximate the workload the chat server might have to service and to evaluate the number of simultaneous connections it could reasonably be expected to handle.

2.2 Interface features

The interface is designed to support the use of colour. 24 bit colour values are specified as a decimal integer.. Chat is in black (zero) by default but this can be altered to make a particular user's text stand out. For example the football commentary system which is broadcast into a supporters chatroom uses red as its text colour to make its messages distinctive. A lecturer's contributions to an educational discussion could be similarly flagged. Currently, however, the ChatterBox client does not allow an individual user to change the colour his/her messages will appear in on each client. This facility was originally made available but has been switched off as feedback from users when it was available was negative. Users did not want multi-coloured chat unless the change of colour had functional significance in a particular application context.

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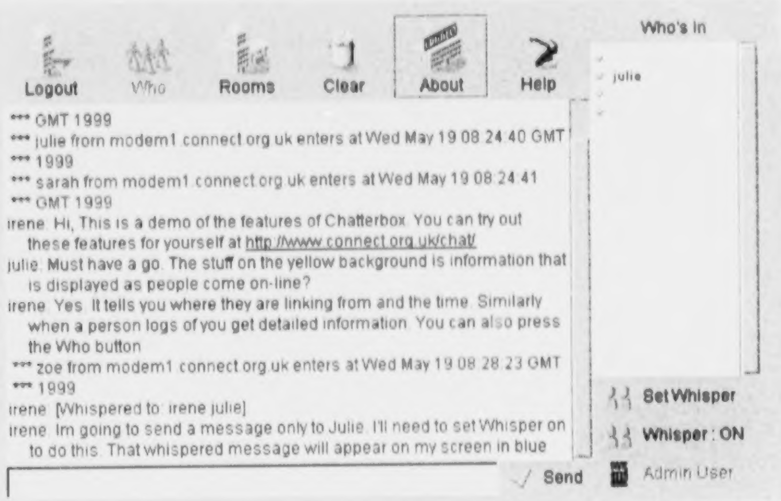
[2] An example of such chat generation software is Parachat, http://www.parachat.com/

Colour is also used to cue *whispered* messages. A user selects those names with whom s/he wishes to communicate and then clicks on the SET WHISPER button. This restricts the display of the message to only the named individuals. Whispered messages are prefaced by a line "[Whispered to: ...]" followed by the names of the recipients of the message and is shown in blue. To reply to this sub-group of individuals a receiver has to set their own whisper function to the appropriate names. The system does not do this automatically. The WHISPER function can be toggled on and off. It is a feature that is frequently employed by users.

The icons used by the chat applet can be made appropriate to a particular context by specifying the relevant image files through the ICONFILE param of the chat client applet Any URL quoted in the text of a message is automatically converted to a hyperlink. The normal user interface to the chat system is illustrated in Figure 1. If a user has superuser status the admin interface would be active and accessible through the admin user button. The admin interface allows a superuser to bar, ban or 'kill' users and to view chatroom statistics such as the load on the server.



```
*** GMT 1999
*** julie from modem1.connect.org.uk enters at Wed May 19 08:24:40 GMT
*** 1999
*** sarah from modem1.connect.org.uk enters at Wed May 19 08:24:41
*** GMT 1999
irene: Hi, This is a demo of the features of Chatterbox. You can try out
    these features for yourself at http://www.connect.org.uk/chat/
julie: Must have a go. The stuff on the yellow background is information that
    is displayed as people come on-line?
irene: Yes. It tells you where they are linking from and the time. Similarly
    when a person logs of you get detailed information. You can also press
    the Who button
*** zoe from modem1.connect.org.uk enters at Wed May 19 08:28:23 GMT
*** 1999
irene: [Whispered to: irene julie]
irene: Im going to send a message only to Julie. I'll need to set Whisper on
    to do this. That whispered message will appear on my screen in blue
```

Figure 1: The ChatterBox Client Interface

2.3 Configurability

Messaging format:- To achieve a highly configurable system, a messaging format was required which would enable messages to be constructed from 'tagged' data sections (in much the same fashion as image formats like IFF and TIFF). Program code could then pick and choose which sections to respond to, ignoring those that were not understood. This would also allow multiple types of information to be encapsulated inside one message. For example the 'remove client' message sent to all clients when someone leaves a chat room could be accompanied by an announcement to that effect suitable for displaying on screen. The format chosen is sown below. All messages are sent in plain ASCII text format.

```
<tag> <data>|<tag> <data>| . . . . . |<tag> <data>
```

A pipe character separates each section. For this reason pipe is not allowed within any section - it was picked because it is a symbol that does not appear in English text and as ChatterBox is based around text communication its absence is unlikely to be noticed. A section begins with a tag name followed by a single space, then the data for that section. A real life example of this format taken from a session in a chatroom is shown below. Note that Laura is communicating with two people, one publicly (D.J.) and the other via whispering (Faisal). CHATMESG is the message itself, CHATWHISPER is a list of users to whom the message will appear if the whisper feature is active.CHATADDUSER is transmitted to all clients to introduce a new user. Lines without a USER section are assumed to be system messages. Other examples can be inspected at http://www.connect.org.uk/chat/

```
    CHATMESG fish from thirl.csc.liv.ac.uk enters at Tue Feb 23 17:22:18 GMT 1999|CHATADDUSER
fish thirl.csc.liv.ac.uk 919790536594 t
    USER D.J.|CHATCOLOUR 0|CHATMESG I can do it now, but they never asked me to in the test
    USER Laura|CHATCOLOUR 0|CHATMESG I have trouble reverse parking as well
    USER Laura|CHATCOLOUR 0|CHATMESG have u sent it yet|CHATWHISPER Laura Faisal
```

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```
    USER Faisal|CHATCOLOUR 0|CHATMESG I'll try to send it|CHATWHISPER Faisal Laura
    CHATDELUSER Laura|CHATMESG Laura from usr217-kno.cableinet.co.uk leaves at Tue Feb 23
17:33:27 GMT 1999
```

Use of Profiles:- A capacity to tailor the functionality of a chatroom to the requirements of particular users could be achieved though the use of profiles. Profiles would also allow some users to be granted 'superuser status' giving them the authority, which itself could be varied, to censor disruptive behaviour via an interface built into the client. This would reduce the need to run a special administration programme server side to manually ban people. Policing by users would also complement the automatic censor system[3].

ChatterBox features an extensive configuration mechanism based upon a main configuration file. Within this the default user and room profiles are defined. A room profile defines variables such as the maximum number of users per room. The default user profile defines variables such as the period of inactivity tolerated, whether swearing, block capital typing, spamming etc are allowed, whether whispering (the selective sending of messages to particular individuals is allowed). This profile will be assigned to any user who logs onto ChatterBox without a specific profile of their own set up in the configuration file. Individual user profiles are created using the COPY attribute from the default profile (a sort of subclassing of the other profile) and are password protected. The following code illustrates the profile of a user who has 'superuser' status on the Anfield Football Chatroom.

```
    <PROFILE=steve_d> COPY=!def_anfield PASSWORD=obscured          KILLUSER=y
BARUSER=y BANUSER=n SEEWHISPER=y SUPER=y   </PROFILE>
```

The user has the name 'steve_d' and a password to secure his username/profile from being used by anyone else. He has been given permission to 'kill' user connections and bar users, but not ban them permanently. He can see all whisper messages regardless of whether he is part of the target subset of users. The final attribute 'SUPER' affords him a red S symbol next to his name in the WHO'S IN list on the chat client applet and access to the ADMIN USER interface.

2.4 Extensibility

Use of Plug-in technology:-The key to making the system extensible was identified as creating the ability for plug-ins to interact with the input and output data streams of the applet. . Plug-ins could be regular classes loaded from the server or other applets resident on the same web page as the client applet . Plug-ins had to be capable of forming could form input-output chains, intercepting outgoing and incoming messages and altering or extending them if necessary. For example, a plug-in could be devised which scrambled the contents of any CHATMESG section on output and unscrambled them on input - ensuring a degree of privacy for dialog sent from client to client. Plug-ins could also be used to control the input/output to other plug-ins.

Use of plug-ins to extend the capabilities of a chat system has the major advantage of leaving the core code of the chat client/server application intact. When a specific feature is needed for a particular chat context, a plug-in is simply used to provide the feature. Customised filtering can also be provided through use of the plug-in system.

Implementation:-Within the ChatterBox system, the procedure for linking in plug-ins is reasonably straightforward. Upon start-up of the chat client applet, a MessageHandler class instance is created which scans the applet's PARAMs for occurrences of 'PLUG_INx' or 'PLUG_OUTx' (where x is an integer number beginning at zero and incrementing with each successive in/out parameter line). The value of each parameter which is found is then parsed. The data is split on the first colon into two fields. The first field is assumed to be the plug-in name, the second is assumed to be a parameter string.

If the plug-in's name begins with an asterisk the MessageHandler looks for an applet using that name. If it does not then the MessageHandler attempts to load and build a class instance of the named type. If the name is simply an asterisk on its own the chat client applet itself is used. All plug-in applet/classes must implement the *Pluginable interface* designed specifically for the ChatterBox plug-in system.

The plug-in class is initialised by passing it environment details such as whether it is being connected to the input or output chain and whether it is being used on a client or server. (Currently however only the ChatterBox client implements the plug-in system.) The parameter string, which formed the second part of the param value, is also passed. Each plug-in can use this string as they wish - ChatterBox makes no assumptions about its contents or purpose. This string is intended to allow individual configuration details for each plug-in to be specified from within the HTML document.

---

[3] Automatic censors are common in chat systems. These monitor all communications and detect system abuses -such as foul language, the sending of messages in ALL CAPS and people vertically writing a message, one character per line. Persistent abusers of the system are generally banned on the basis of their IP addresses or hostnames. In some cases, where IP addresses are dynamically assigned, this might necessitate the banning of a range of addresses using a wildcard option

Two chains are formed, one for input and one for output. The plug-ins are linked in numerical order based upon the PLUG_INx / PLUG_OUTx value, from low to high. Once these chains are created they are passed any outgoing message from the client chat applet prior to it being transmitted and any incoming message prior to being processed by the client software itself. Each plug-in in turn is passed the message in a Hashtable format - with each section of the message stored hashed by its tag name.

This is where the sectioned/tagged format of ChatterBox's message system is particularly beneficial. Each plug-in can then append, remove or replace sections of each message before allowing it to be passed down the chain. They can deal specifically with those sections of the message that they understand and ignore all other content - including those added by other plug-ins previously on the chain. Once the end of the chain is reached the message is transmitted (for output) or delivered to the client (for input).

Examples of use: A series of demonstrations of the plug-in system and the capabilities of ChatterBox in general is provided at http://www.connect.org.uk/chat/. Two examples are included within this paper for illustration. The first example is of the Debug Plug-in. The Debug Plug-in simply displays to a TextArea AWT widget the entire contents of messages being passed in and out of the client chat applet. It is a useful plug-in in that it allows the actions of other plug-ins to be monitored. The Debug Plug-in is inserted into the input and output chain of the client chat applet simply by including the HTML fragment below.

```
 <PARAM NAME="PLUG_IN0" VALUE="*Debug:In> ">
<PARAM NAME="PLUG_OUT0" VALUE="*Debug:Out> ">
```

Figure 2 is a screen dump of the client applet with the Debug plug-in running. The output generated by the Debug plug-in is displayed in the TextArea below the client chat applet display. Thus Debug OUT displays all chat messages transmitted between client and server in the ChatterBox system while Debug IN displays all messages sent by the server to the client, many of which will contain text for display within the chatroom.

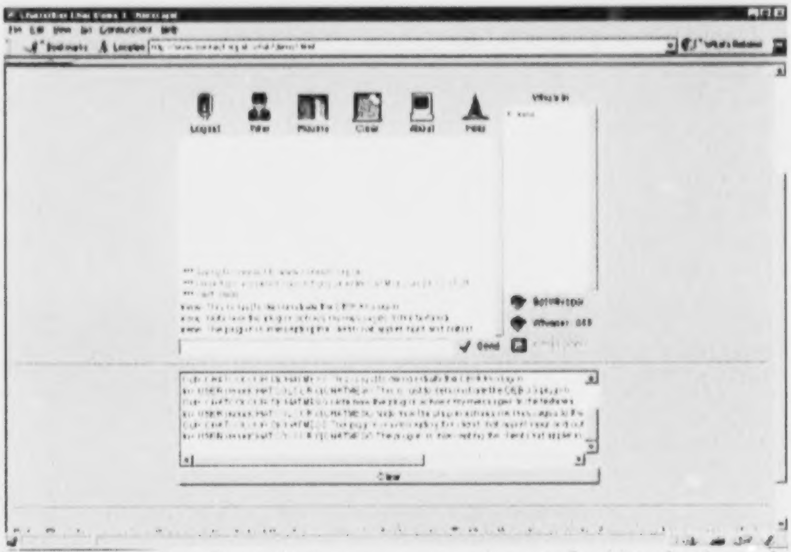

Figure 2: The Debug Plug-in displays messages passing out of and into the chat applet

In our second example, illustrated in Figure 3, a different plug-in, called 'Test' has been inserted in both the input and output chain of the applet by inclusion of the HTML fragment shown below.

```
<PARAM NAME="PLUG_IN0" VALUE="*Test:-">
<PARAM NAME="PLUG_OUT0" VALUE="*Test:-">
```

This plug-in displays the total number of characters etc sent in the CHATMESG section of the message for input and output. It also allows the user to modify the value of the CHATCOLOUR section to change the text colour used to render a transmitted message in all chat client. Different types of messages can thus be colour coded.

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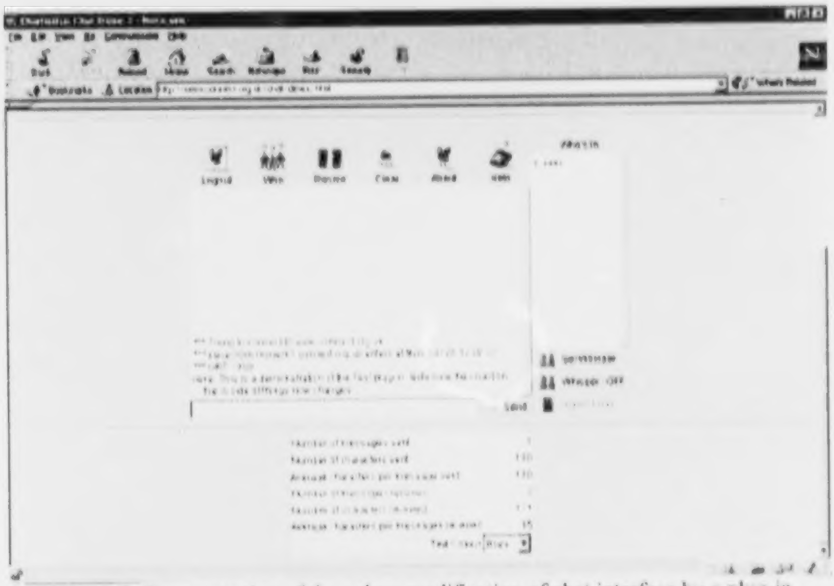

Figure 3: Demonstration of the colour modification of chat interface by a plug-in

3. Further developments

The plug-in system allows the client chat applet to be extended without the need to alter the client code itself. While the potential applications of the technology are considerable - effectively it offers outside programs complete control over the ChatterBox's chat client's input and output - there is also scope for improving the system.

Firstly, the fact that plug-ins are tied only to the input and output of the client is a major limitation in that they can only act when the client sends or receives messages. A system where by plug-ins can initiate their own outgoing messages without having to wait for the chat client to send would be more desirable. Originally the plug-in system was seen as serving only the client itself - but with the ability of applets to be used as plug-ins it became clear that this was unduly limiting. Because applets can be entire mini-applications they might need better network support than that provided by the chat client messaging system alone. Secondly, if a plug-in requires a user interface it must utilise a separate applet on the same web page as the client chat applet. It would be advantageous if plug-ins could supply their own UI components within the client's interface, supplementing or perhaps replacing the standard chat area component. Finally, the plug-in configuration is limited to a single string in the PLUG_INx / PLUG_OUTx param line - unless the plug-in reads it's own configuration file from the network. It would be useful if the configuration files associated with plug-ins could be stored as part of the main ChatterBox user/room configuration file.

Other unique features of the system could be further exploited. For example, in many chat system users are effectively anonymous - in that they had no permanent presence on the system. The introduction of user profiles users however effectively gives users an 'account' on the chat system. The personal information by the profiling system could be used in a variety of ways. For example if ChatterBox was deployed in a distance learning context, the ability to look up a lecturer's specialist interests, office and phone details during an on-line conference could prove useful. Highly configurable and extensible systems such as ChatterBox are needed to provide the flexible environments required by the growth of interest in distributed discussion groups.

4. References

Laurillard, D. (1993. *Rethinking University Teaching*. Routledge

McKendree, J. and Mayes, T. (1997). The Vicarious Learner: investing the benefits of observing peer dialogue. In *Proceedings of CAL'97*, Exeter, UK.

Neilson, I., Thomas, R., Smeaton, C., Slater, A., and G. Chand (1996). Education 2000: Implications of W3 Technology, *Computers and Education*, 26 (1) 113-122

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Toward a Standardized Internet Measurement

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Abstract: This paper investigates measurement issues related to elements of the Internet and calls for a standardized measuring scheme to resolve the problem of the measurement. In this paper, the dilemmas in measuring the elements of the Internet are identified and previous studies are reviewed. Elements of the Internet are categorized into population, usage, protocol flow, hardware, software, traffic, and visitors. At last, this paper proposes four criteria in measuring the elements of the Internet as the guidelines for Internet research.

1. Introduction

This paper investigates the dilemmas in measuring the elements of the Internet and reviews current attempts in monitoring the growth of the Internet. By examining these important issues, this paper aims to provide guidelines and criteria in measuring the entity of the Internet for further research.

The original ARPANET evolved into the present day Internet which itself has changed much in the last two decades since it came into existence. During the late 1980s, the population of Internet users and network constituents expanded internationally and began to include commercial facilities [Cerf 1998]. Today the Internet is made up of private networking facilities in educational and research institutions, businesses, and government organizations across the globe. It was developed in the era of time-sharing, but has survived into the era of personal computers, client-server architecture, peer-to-peer computing, and network computers [Leiner et al. 1998].

From a human perspective, no single person or single organization has contributed totally or controlled the growth and the development of the Internet. From a technological perspective, from 1969 to 1975, when the Internet (called APRANET) was still in a research and development period, drawing maps and topology diagrams, calculating traffic and performance statistics, and measuring the size and diffusion of the net were feasible. After 1975, when the Internet was turned over to the Department of Defense, tracking the Internet became a headache for the National Science Foundation [Press 1997]. Today, as more and more border-crossing backbones have been further developed and intermesh, tracking the development of the Internet and measuring related growth elements has become harder and harder.

Since it came into existence, the Internet has grown beyond its initial purposes and includes both a broad user community and increased commercial activity. Over the years, the Internet has become a medium with world-wide broadcasting capability; a mechanism for information dissemination; and a medium for collaboration and interaction between individuals and their computers by overcoming obstacles of distance [Leiner et al. 1998]. From a marketing perspective, the Internet represents one of the most successful examples of the benefits of sustained investment and commitment to businesses; and for academic researchers, the diffusion of the Internet represents an interesting phenomenon needing further diagnosis with scientific explorations [Morris & Ogan 1996].

Depending on how the Internet is viewed and what units of analysis are defined, studying elements of the Internet can generate different interpretations and different meanings. There is an urgent need to understand the growth of the Internet. In one sense, the Internet is rapidly growing in its number of users, its volume of protocol traffic, its complexity of topologies, its impacts on human beings' lifestyles, its value in economic activities, and its coverage. In another sense, the global diffusion of the Internet, the fostered knowledge organized by the Internet, the changes in users' behavior, and the impacts to human beings' global perspectives are intriguing issues in academic fields. More explorations of these phenomena would increase our understanding of the implications of this global technology and how it can potentially affect the lives of human beings.

As the Internet continues to evolve, the need to increase our understanding of the elements of the Internet becomes more urgent. Especially, we need a feasible and acceptable standard of Internet measurement which can allow us to monitor, track, and compare the size of the Internet, the growth rate of the Internet, the usage of the Internet, and the attributes of the Internet. This paper first investigates dilemmas to which researchers encounter when measuring the elements of the Internet. Further, related studies in measuring the elements of the Internet through are reviewed. This paper then provides a few useful criteria in resolving dilemmas of the measurement of the Internet.

2. Dilemmas in Measuring the Internet Elements

Since the Internet is rapidly growing in different dimensions, measuring the Internet from different perspectives becomes more important. However, researchers do not know exactly what to measure and how to measure this multi-dimension issue. Previous studies, such as [Novak & Hoffman 1997, Hoffman & Novak 1996] suggested that lacking the standards for what to measure and how to measure the element of the Internet would limit industries' further participation in the Internet activities. Today, different units of analysis were used when researchers attempted to measure the Internet [December 1996]. Under the circumstance of lacking guidelines and criteria, the problems of inconsistency arose and the results were controversy, and contradicted to each other in many areas.

Depending on how the Internet is viewed and what units of analysis are defined, measuring the elements of the Internet may generate different interpretations. For example, from the new technology viewpoint, the Internet can be measured as its penetration rate, adoptions of innovations, and its evolvement during diffusion process. When taking the viewpoint as mass medium, the measurement of the Internet may then focus on one-to-one, many-to-one, or one-to-many communication schemes, as well as send, recipients and message contents. If the Internet is studied as a CMC (computer mediated communication) multimedia environment, researchers may tend to explore hits, visits, uses and effects of the Internet for its commercial purposes. If the view of information dissemination is taken, it is then possible that researchers would study issues involving information flow across border, content censorship and regulation, or topics related to search engines. If a more behavior-orientated approach is taken, researchers would focus on demographics. From the geographical view, the measurement of Internet then becomes which university, town, city, state or country has the highest penetration rate. From the point of view of economics, researches may look at the relationships between economic development and the uses of the Internet on the linkages between telecommunication and trade flows in the economy.

3. Reviews of Internet Measurement

In order to establish baseline data for standardized procedures of the Internet measurement, the authors reviewed previous empirical studies researched on the Internet measurement issues. When reviewing such a rich data over time, we have limited ourselves on three questions: What were measured? Why were they measured? and How have they been measured? We sought the answers during our review process and later realized that the answers and the questions are intertwined. In reality, how the elements of the Internet were measured and what were measured actually depends upon how the final statistical numbers were used. Different research procedures and methodologies serve different purposes.

In the reviewing process, we made no attempt to review all previous studies. Rather, we tried to extend dimension of the Internet measurement as diverse as possible. Therefore, in this paper we did not list all similar studies in the same dimension. We have created two criteria when constructing this list. First, they must be empirical studies. Second, they must be able to make comparisons with other. To meet the first criterion, a study should provide its detailed description of methodology. To meet the second criterion, a study should present its results by numerical statements. From our preliminary literature review from traditional press format as well as the Internet, we were able to categorize the measurement of the Internet into the following categories:

3. 1. Population

The most common measurement of the Internet is about the Internet population. Virtually, there is no way to determine how many users are on the net without making guesses. The approach of counting human heads usually includes two sub-categories: number of users in a social system and attributes of demographics. The former refers to those studies investigating "how many" research questions, such as "How many Internet (adult or kid) users in United States or in the world" (e.g., http://www.nua.ie/surveys, http://www.cyberdialogue.com/free_data/index.html, and http://www.commerce.net/news/press/fact0699.html), "How many Web users in California State?" (http://www.commerce.net/news/press/030398_1.html) "What's the most wired big city in the country?" (http://www.zdnet.com/yil/content/mag/9803/wired.html) or "Which city in the United States owns the highest penetration rate of the Internet?" (http://www.commerce.net/news/press/030398_1.html) The later refers to those studies investigating "Who are they" questions, such as "What is the age range for those Internet users in June 1998?", "What are their educational background?" and "Are male users still more than female users?" (e.g., (http://www.gvu.gatech.edu/user_surveys/survey-1998-10/) The methodologies used to elicit the population number and attributes were through a telephone survey or through a self-administered Web survey. In the telephone survey, usually random sampling technique and statistical inference were used. In the Web survey, they usually suffered from problems of convenience sample.

3.2. Use

In addition to the study of Internet population, the usage of the Internet is also one of researchers' concerns. This approach attempts to answer the "how often" question. In order to investigate the "frequency" question, researchers usually conduct a telephone survey or a Web based survey. Usually, respondents were asked to identify the time of their last access to the Internet, hours of using the Internet per week, number of years of using the Internet, their Internet connection speed and so on (e.g., http://www.gvu.gatech.edu/user_surveys/survey-1998-10/). Using the methodology of telephone interview or Web based survey to answer "how often" questions usually generated distorted data. For example, because respondents were asked to describe their past experiences with memory, the results may not represent the truth. Respondents tend to increase the number of their Internet uses when asked, and in some cases, respondents are confused with the meaning of "uses."

3.3 Protocol flow

The Internet is comprised of several application layer of TCP/IP, such as HTTP, FTP, SMTP, POP and NNTP. Some of protocols, which have been very active and popular on the Internet, are now fading away (Gopher and Hypernet) while other new protocols (HTTP and POP) provide the majority traffic. One of purposes in measuring the application layer protocols is to observe their variations and to predict the trends of future developments, in addition to the performance of data flow in a timely manner [Monk & Claffy 1997]. In order to predict and observe the trend, research focusing on the protocol measurement should not limit their studies to one shot, and should extend their studies over time. Unlike the measurement of the Internet traffic (discussed later in this section), measuring the Internet protocol focuses on the comparisons among different protocols, their growth and decay over time, and the patterns of traffic flow. They look at the traffic of packets, bytes and flow in a specific time interval and monitor how Internet protocols flow over backbones [Apisdorf et al. 1997]. The traffic flow may include flow type (which protocol is observed), source/destinations of traffic (efficiency of traffic flow) and distributions of packet sizes and duration (effectiveness of networking) [Monk & Claffy 1997]. Today, however, it is practically almost impossible and cost prohibitive to detect the variation of protocols on the whole Internet because there are more than 30 backbone in the United States and more around the world. Detecting the bit flow over backbones in different time slots would be tedious with a considerable expense, if not possible.

3.4. Hardware

Previous attempts in measuring the size and the growth of the hardware focus on the Internet hosts and the Internet domains. See Robert H'obbes' Zakon's Internet Timeline v3.3 (http://www.isoc.org/guest/zakon/Internet/History/HIT.html) for the full description of these data and Netsizer for a commercial tool serving this purpose (http://www.netsizer.com). Understanding the number of domain or hosts worldwide or in a specific country may potentially increase our knowledge of the diffusion process of the Internet. Since the adoption rate of hardware may relate to culture, social and economic issues, analyzing these data can also contribute to our understandings of the Internet diffusion and societal factors. The basic procedure to collect data of hardware number is to ping the IP addresses through the Internet. By adding the replies after pinging, it is then possible to find out a total number of hosts and domains on the Internet. There are a few potential limitations of using this approach to measure the Internet. First, when some parts of the Internet choose to limit access to themselves to various degrees, the data collected would be distorted. To solve the above problems, researchers in Network Wizards (http://www.nw.com) created another new survey methodology in 1998 (http://www.nw.com/zone/WWW/new-survey.html). In their survey, in stead of ping every 4.3 billion IP address on the Internet, they tried 879,212 delegations, or just 223,319,848 possible hosts. The potential problem of this newer methodology is that the degree of the precision decreases. Second, in order to collect data over time, researchers need to conduct this procedure frequently. This would increase the unnecessary traffic of the Internet. Third, as the Internet becomes bigger and bigger, it then turns out practically impossible to ping over the Internet in a short time frame. Fourth, the definition of a host has changed in recent years due to virtual hosting. Today, a single machine can act like multiple systems with multiple domain names and IP addresses. Fifth, since an increasing number of domain names are registered in the USA, instead of in their own countries, the measurement of domain names becomes less meaningful.

3.5. Software

The war between Microsoft and Netscape is not about browsers but about the standard. Measuring the Internet software can reveal the fact which software dominates the Internet by studying the ration of their market sharing. Software related to the Internet use includes two parts: server and clients. As Web technology becomes prosperous, studies of Internet software basically focus on Web server applications and Web client applications. The methodology used to collect data of Web server applications and Web client applications are different. To detect which Web server application is running in a Web site, researchers can simply send a request for server's header by using HTTP. Researchers can then parse server's initial response to identify the server type. In June 1999, the Netcraft Web Server Survey (http://www.netcraft.com/survey) received 6,177,453 responses from their systematical poll. In their report, Apache takes 56.19% of the Internet Web server market while Microsoft IIS, 22.34%. To find out which Web browsers a Web user is using, researchers can use general telephone survey (http://www.psrinc.com/browser.htm) or just analyze the log file automatically stored in a Web server' directory. When a link between a Web browser and a Web server is established, a browser sends its browser type as "User-Agent" to Web server for recognition and communication purpose. Therefore, if a researcher can access log files from some popular Web sites, he should be able to tell the ratio to which each Web browser takes. By studying 2,000,000 Internet session data points over a time period of 21 months, Positive Support Review reported in June 1999 that Microsoft's Internet Explorer's market share has remained consistent in recent months, reaching as high as 66.61% (http://www.psrinc.com/PressRelease/PR_19990623.htm).

3.6. Traffic

Traditionally, issues of traffic are researchers' most concerns in the field of telecommunications because traffic data represent the precision and intensity of activities in a distributed communication environment. By analyzing traffic data, researchers can reveal a clear image of data flow in terms of amounts, directions, and growth. Changes in traffic volume can provide information related to "carrier productivity, tariff levels, market entry and the basis for settlements between interconnecting carriers, both domestic and foreign" [Staple & Mullins, 1989]. Besides, traffic data involves some complicated issues, such as information flow and content regulation. Crossed-border information basically is not a problem when the information per se is neutral and acceptable by people on the other side of border. It starts to cause troubles when the information is considered biased or unhealthy. When a country wants to keep its traditional values, like Singapore, from pollution of the Internet, content regulation becomes a necessary step to shut out border across information. Traffic can be measured by its total amount of bit passing through backbones in a time slot or by the amount of data passing through borders. Measuring the traffic flow on the Internet requires a higher degree of cooperation and involvement by service providers as well as multiple-nation cooperation. In order to make the data sensible, traffic measurement should be conducted over time and make comparisons periodically. In late 1995, Munzner et al. [Munzner et al. 1996] created a visually depicting Internet traffic components, which displayed how information on the Internet was routed over national borders.

3.7. Visitor

Measuring the number of visitors to a Web site or a Web page has its industry value because this summarized number is considered highly correlated to the exposure and interactivity of advertisements on the Web. Several different reporting schemes have been created, such as reach, frequency, duration time, and exposure. Unfortunately, there is no consensus on the definitions of these terms. See [Novak & Hoffman 1997] for detailed discussions of these terms. Those measurement units include hit, request, visits, user, organization, request duration, visit duration, Ad view, Ad click, Ad yield and Geography (see the example in United Expressline Web site: http://www.unxpres.com/usage/summary.html). Basically, to measure the effectiveness of a Web site or a set of Web pages includes counting and summarizing the visitor transactions on a Web site. Data from these counting processes may summarize who visited (visitor identities), when they visited (visitors' accessing time), where they were from (referred Web pages or entry point), what they visited (linkages between Web pages), how long they have stayed (elapse time), what they have done (transactions and interactivities), and where they exit (exit point). These summarized reports may tell managers a possible way to adjust the content and organization of his Web site, also how to charge clients of a Web site's advertisement. Besides, by applying this concept to a Internet Web site, it is then possible to compare the hottest Web sites on the Internet, usually measured by visits & hits.

4. Analysis

The Internet itself, especially with the view of marketing, is characterized by uncertainty. As suggested by [Hoffman & Novak 1997], one way to decrease this feeling of uncertainty is to build up an open methodological standard. However, we tend to argue that today's Internet is like frontier of the big West in the 18th century, where orders and procedures were yet constructed. Further, as the Internet keeps evolving with an accelerated rate, newly contrived procedures and orders may soon be collapsed due to their inability to adapt to the newly evolved world. To decrease the uncertainty and to increase our understanding of the elements of the Internet, a practical and acceptable measuring scheme should be established and a standard of measurement should also be built up.

However, after reviewing those attempts in measuring the elements of the Internet through diverse dimensions, the authors tend to believe that building a standardized, universally acceptable scheme for the measurement of the Internet is not feasible yet. Since the methodology aims to resolve research questions and should be consistent with research purposes, different research purposes would generate different methodologies. A standardized measuring scheme that aims to resolve all research questions related to elements of the Internet could actually be difficult to achiee. Nevertheless, the authors tend to believe building up some general guidelines which may be applied to all diverse research issues is still necessary and possible.

After reviewing those studies related to the measurement of the elements of the Internet, the following guidelines are proposed. These guidelines, which may be applied to different environment, attempt reveal the essential characteristics in measuring the Internet.

First, many studies, which investigated the elements of the Internet, are under the threats of validity and reliability. Due to the uncertainty characteristic built into the Internet, any researchers who want to study the elements of the Internet should first attempt to solve the problems of validity and reliability. Further, validity and reliability check should be the first criterion built into research designs and should be reported in detail

Second, the continuation of the study should be taken care. Since the Internet is evolving, growing up and expanding, the process of data collection should be extended to a longer session. The continuation of the data collection is necessary otherwise the results concluded from today's data may not be effectively in predicting tomorrow's situations. In most cases, multiple data collections over time are required to make meaningful and practical conclusions.

Third, human beings' Internet behaviors are constantly changing. Therefore, the period of data collection should be limited to days, not months. The Internet is like an arena, where different forces keep fighting and wrestling. Consequently, human beings' behaviors are open to change while the external environment constantly moves to different directions. The characteristic of the fast Internet evolution may influence the pattern of data, which later may invalidate analysis. For other academic and scientific research, the researching settings are relatively stable. Even though in some situations the research context may change, these variations are usually observable. It is very different on the Internet.

Fourth, if a methodology can accommodate to serve multiple users' needs and answer multiple questions through different dimensions at the same time, this methodology would be more desirable and useful [Staple and Mullins 1989]. This criterion is important because it can not only limit the resources invested on the Internet but also limit the Internet traffic.

5. Conclusion

In summary, in this paper we have discussed the needs of studying elements of the Internet and dilemmas of measuring the elements of the Internet. We also reviewed previous studies that attempted to measure the elements of the Internet. From the knowledge we learned from the reviewing process, we proposed four criteria, which should be followed in conducting research in measuring the elements of the Internet.

6. Reference

Apisdorf, J., Claffy, K., & Thompson, K.. (1997). OC3MON: Flexible, Affordable, High-Performance Statistics Collection. Proceedings of INET 97. http://www.isoc.org/inet97/proceedings/F1/F1_2.HTM.

Cerf, Vint. (1998). Brief History of the Internet. http://www.isoc.org/internet-history/cerf.html.

December, John. (1996). Units of Analysis of Internet Communication. Journal of Communication 46(1), Winter. 14-38.

Hoffman, D.L., W.D. Kalsbeek and T.P. Novak (1996), "Internet and Web Use in the United States: Baselines for Commercial Development," Special Section on "Internet in the Home," Communications of the ACM, 39 (December), 36-46.

Leiner, B. M., Cerf, V. G., Clark, D. D., Kahn, R. E., Kleinrock, L., Lynch, D. C., Postel, J., Roberts, L. G. & Wolff, S. (1998). A Brief History of the Internet. http://www.isoc.org/internet-history/brief.html.

Monk, Tracie & Claffy, K. (1997). Internet Data Acquisiton and Analysis: Status and Next Step. http://www.isoc.org/inet97/proceedings/F1/F1_3.HTM.

Morris, Merrill and Ogan, Christine. (1996). The Internet as Mass Medium. Journal of Communication. 46(1), Winter. 39-50.

Munzner, T., Hoffman, E., Claffy, K. & Fenner, B. (1996). Visualizing the Global Topology of the Mbone. Proceedings of the 1996 IEEE Symposium on Information Visualization, pp. 85-92, October 28-29 1996, San Francisco, CA, 1996.

Novak, T.P. and D.L. Hoffman (1997), "New Metrics for New Media: Toward the Development of Web Measurement Standards," World Wide Web Journal, Winter, 2(1), 213-246.

Press, Larry. (1997) Tracking the global diffusion of the Internet. Communications of the ACM, Nov 1997 v40 n11 p11(7).

Staple, Gregory C. & Mullins, Mark. (1989). Telecom Traffic Statistics -- MiTT Matter: Improving economic Forecasting and Regulatory Policy. Telecommunications Policy, June (1989): 105-127.

Arcade: A Web-Java Based Framework for Distributed Computing

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Abstract: Distributed heterogeneous environments are being increasingly used to execute a variety of large size simulation and computational problems. We are developing Arcade, a web-based environment to design, execute, monitor, and control distributed applications. These targeted applications consist of independent heterogeneous modules which can be executed on a distributed heterogeneous environment. In this paper we describe the overall design of the system and discuss the prototype implementation of the core functionalities required to support such a framework.

1 Introduction

Distributed heterogeneous environments are being increasingly used to execute a variety of large size simulation and computational problems. For instance, in multidisciplinary optimization, multiple heterogeneous modules interact with each other to solve an overall design problem. Typically these modules, consisting of various C or Fortran programs, are developed as separate codes, e.g., structural or flow analysis of an aircraft configuration, and are optimized independently. The traditional path for integrating these modules, through the use of scripts makes the process of specifying and optimizing the overall design of such applications, a long and tedious process often taking several weeks. The slowness of this process is mainly due to the absence of a collaborative environment where (i) different modules and their interactions can be specified, and (ii) testing, monitoring, and steering of the overall design can be done by multiple users from different disciplines concurrently. In this paper we describe Arcade, a web-based environment for designing, executing, monitoring, and controlling distributed heterogeneous applications.

A typical scenario for developing and executing a distributed application is as follows: A team of designers collaboratively develops the application consisting of a hierarchical set of modules. That is, individual members are made responsible for specifying the submodules while the project leader is responsible for the overall integration of the application, i.e., connecting the outputs of one module to the inputs of another. The modules can range from simple sequential programs, to data parallel programs capable of execution on a multiprocessor or a network of workstations, to more complex subsystems which are defined hierarchically through the use of submodules. Preexisting modules whose sources are not available may need to be "wrapped" in order to plug them into the overall application.

Once developed, the application is executed in a distributed environment using a heterogeneous network of workstations and multiprocessor machines. During the execution, team members sitting at their individual workstations simultaneously monitor the flow of progress of the application. That is, the team members can see the currently executing modules at any level of the hierarchy. They can also view the intermediate data flowing between different modules including view large data sets using visualization tools.

A team member responsible for a particular subsystem can change data values under the control of the subsystem in order to steer the computation in the right direction. The team member can also dynamically alter the control flow if necessary. For example, in a design cycle, the responsible team member may decide that a particular module is not affecting the optimization and may bypass the module by using old values in each cycle. Similarly, the team could replace a module with a plug compatible module, for example, to use another algorithm. Once the execution is complete, team members again examine the final results using the visualization tools.

The overall goal is to design an environment which is easy to use, easily accessible, portable and provides support through all phases of the application development and execution. We plan to leverage off of commodity technologies, such as the Web and Java, to implement various parts of the environment. These technologies are capable of seamlessly interconnecting disparate hardware platforms running different operating systems across diverse locations providing an ideal environment for distributed simulation of complex systems.

In this paper we first describe our overall goals and then discuss the current prototype reporting on our experiences and problems in implementing the system. The rest of the paper is organized as follows. In the next section we present some related work. The two following sections describe the overall Arcade architecture and the current prototype, respectively. The last section focuses on future work and conclusions.

2 Related Work

Several software systems have been developed that make distributed computing available to an application programmer. These can be distinguished into different categories. The first category of environments includes systems such as MPI [MPI 1997], PVM [Sunderam 1990], pPVM [Maly et al. 1994] and JAVADC [Chen et al. 1997]. All these environments support distributed computing in varying degrees of generality; however, either they are not web based or they lack collaborative features. Also, they are mostly suitable for running SPMD programs. The second category of environments address large distributed heterogeneous codes but are focused on a single application domain. Examples of such environments include FIDO [Weston et al. 1994] and MIDAS [Midas 1999]. However, both these systems are either hardwired to a specific problem areas or are too restrictive. The other major limitation is that they lack a collaborative environment which would permit different members in a group to interact with the application at various stages of its design and execution.

The third category of environments which includes IceT [Gray & Sunderam 1997], Programmer's Playground [Goldman et al. 1995], PRE [PRE 1999], and WebFlow [Bhatia et al. 1997] supports heterogeneous distributed applications in some form or the other. The front-end for most of these systems, is generally some variation of large-grained data flow graphs with modules being triggered when their inputs are available. In our experience, we have found that to easily express heterogeneous applications requires more control structure than provided by such data-flow based systems. For example, in a multidisciplinary optimization code, the optimization cycle would have to be embedded within a module in a system which only supports data-flow rather than being explicit at the outer level. Also, these systems mainly concentrate on different aspects of the infrastructure required for managing the execution and interaction of the modules making up the application whereas the goal of the project described here, is to build an integrated framework for all phases of the design and execution of distributed heterogeneous applications. Note that systems such as Tango [Beca et al. 1999] and Habanero [Habanero 1999] focus on interactive collaboration between users. Such technologies would be useful in the specification and the monitoring phases of the framework being proposed here. However, such collaborative systems do not provide any support for the management and steering of the execution of distributed applications.

3 Arcade Architecture

The architecture of the proposed framework is divided into three tiers as shown in [Fig. 1].

First Tier: The first tier consists of the Java applets providing the following interfaces to the users:

- *Application design interface* for the hierarchical specification of execution modules and their dependencies. The system will provide support for multi-user specification of heirarchical modules including the specification of module interactions and database access for persistent storage of results.
- *Resource allocation and execution interface* for specifying the hardware resources required for the execution of the application. The resources could be chosen by the users or by the system based on the current and predicted loads of the system and the characteristics of the application. The choice could be made statically or dynamically during the execution of the application. The system will also allow

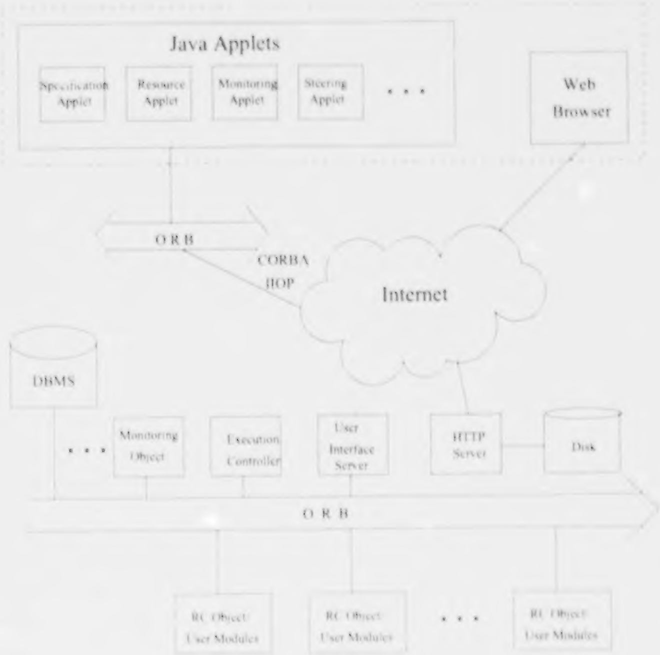
Java Applets
Specification Applet
Resource Applet
Monitoring Applet
Steering Applet
. . .
Web Browser
O R B
CORBA
IIOP
Internet
DBMS
. . .
Monitoring Object
Execution Controller
User Interface Server
HTTP Server
Disk
O R B
RC Object/ User Modules
RC Object/ User Modules
. . .
RC Object/ User Modules

Figure 1: Web Object Infrastructure for the proposed Framework

the users to choose the input/output files and any command line arguments for the modules prior to starting the execution.

- *Monitoring and steering interface* for monitoring and controlling the execution of the application. Multiple users will be allowed to monitor the run both the flow of execution and the intermediate results. However only the subteam responsible for a particular submodule will be allowed to steer its execution by either modifying data values or replacing plug-compatible modules.

Middle Tier: The middle tier consists of logic to process the user input and to interact with application modules running on a heterogeneous set of machines. The overall design is a client-server based architecture in which the *Interface Server* interacts with the front-end client to provide the information and services as needed by the client. When the user requests the execution of an application, the Interface Server launches an *Execution Controller (EC)* which manages the overall execution of the application by firing up user modules on the specified resources as and when required. Other objects in the middle tier handle any monitoring and steering requests from the client.

Third Tier: The third tier consists of *Resource Controllers (RC)* and the *User Application Modules*. Each active resource in the execution environment is managed by a RC which is responsible for launching modules on the resource and also for interacting with the Execution Controller in order to keep track of the executing applications.

The main advantage of a three-tier system is that the client or the front-end becomes very thin, thus making it feasible to run on low-end machines. Also, since most of the logic is embodied in the middle tier, the RCs can be kept lightweight thus keeping the additional loads on the executing machines to a minimum also.

The Web Object approach we are taking will coexist with the regular HTTP server. In contrast to approaches with CGI-to-CORBA gateway or HTTP-to-IIOP gateways, this approach is easier to implement [Orfali & Harkey 1997]. Here, the HTTP server will provide users Web pages with Java applets. These

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applets will interact with the CORBA Interface server using CORBA-IIOP protocol. The applets can use static IDL-generated client stubs or a Dynamic Invocation Interface to interact with the CORBA Interface server. The CORBA Interface server will interact in similar manner with other objects on the ORB bus (see [Fig. 1]).

4 Arcade Prototype

We have implemented the three-tier system as described in the last section, in a prototype Arcade system. The current system allows single users to specify applications through either an offline script-based system or through a visual interface. The resources required for the execution have to be statically specified by the user. The current prototype supports only file-based interaction among the modules. The system manages the execution of the modules on a network of workstations in a single domain. The execution status of the application can be monitored by multiple users simultaneously.

4.1 Application Specification

In our framework a distributed application consists of a collection of heterogeneous modules (application codes from different disciplines). We are targeting applications where these modules are very coarse grained. A typical distributed application requires these modules to be executed in some order and possibly on different machines. For certain problems, a set of modules may need to be executed iteratively, for example, until a desired optimization criteria is reached. To be able to support a wide variety of distributed applications, we support the following types of modules: *Normal Module*, the basic module in our framework used to represent the executable parts in the applications; *Control modules*, which support control structure, such as, if and loops; *SPMD Module*, for internal parallelism; and *Hierarchical Module* for module abstraction.

In the current prototype there are two ways to specify a distributed applications: *script based* or *visual*. The syntax of the script used for textual specification in Arcade is simple, allowing users to specify the different modules, as described above along with the properties of these modules including interconnections.

The visual specification applet allows a user to graphically specify a heterogeneous application. The objective is to support a visual specification which is: (i) intuitive to build, (ii) can be used for visual monitoring, and (iii) works with the Web. There exist a number of visual language projects – see [Burnett & Baker 1994] for a classification of many of these projects. However, most of the projects which support program specification are either focussed on fine-grained programming or support only data-flow applications. That is, they do not provide any integrated, intuitive approach to specify control constructs in a coarse grained distributed applications.

We have implemented a Java applet that provides a visual specification interface and addresses some of these issues (see [Fig. 2]). The visual specification can be seen as a graph where a node represents a module and the arcs represents data flow. It is easy to see how a data flow based application can be modeled using such a system. It becomes a little trickier to accommodate control structures such as conditionals and iterations, in particular when we want to use the visual specification for monitoring too. We accommodate if-modules and loop-modules by restricting their bodies to be hierarchical modules which are specified through a separate window. Thus, the modules labeled *Then-block* and *Else-block* represent hierarchical modules abstracting the then and else part of if construct respectively. Similarly, the module *Body*, represents the loop body of the while loop. Restricting the bodies of control structures to hierarchical modules eases the task of specification and allows the application to be visually represented. However, it does not provide an integrated view of the whole application in a single window, i.e., the body of a control structure is always shown in a separate window.

4.2 Application Execution

Each application is internally represented by a Java `Project` object. The `Project` object, consisting of a vector of modules objects, is the central object in our framework. All the information related to the application, both static and dynamic, is stored within this object. The `Project` object is a complex object that is shared by all the processes of the middle tier (see [Fig. 1]) and supports methods that are used by these processes. When the user requests the execution of an application, the *User Interface Server* passes

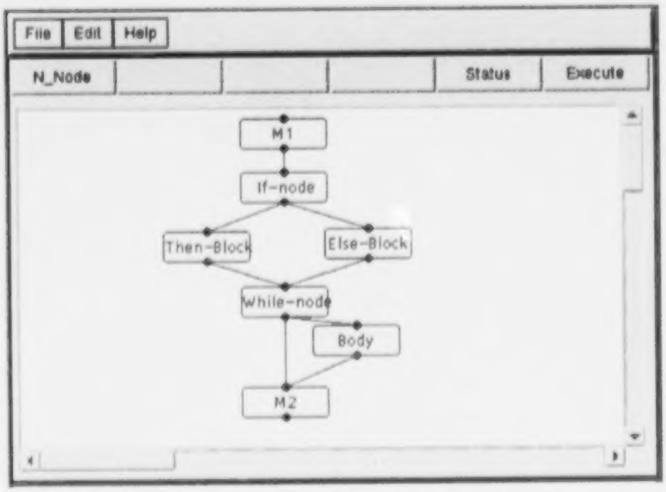

Figure 2: Visual Specification Interface

the corresponding `Project` object to the *Execution Controller (EC)*. It is the EC's responsibility to manage the execution and the interaction of the modules specified within the application.

For executing the application, the EC needs to call some initialization methods of the `Project` object followed by its execution method. For example, if the application has been specified using the script-based mechanism, then the dependencies (which had been specified implicitly) have to explicitly computed and stored. The EC then executes the modules using a data-flow approach. That is, it launches the execution of a module as soon as its inputs are available. Note that the interaction in the current system is based on files. Thus, the EC has to ensure that the inputs for a module are in the files as specified in the project specification. That is, if a module produces a file which is physically different from the file specified as an input file by a dependent module, the EC copies the file over before execution is started. Here we are assuming that the application is executing in a single domain with a global file system so that copying files does not raise any security issues.

The system requires the user to specify the resource on which each module is to be executed in the application specification. Thus, to execute a module, the EC contacts the Resource Controller (RC) on the specified resource and requests that the module be executed. The RC starts the execution and monitors it. The RC notifies the EC when the module finishes execution. This allows the EC to determine the modules were dependent on this module and launch their execution if all of their inputs are ready. Once all the modules have finished execution, the user can be notified.

A monitoring applet allows users to monitor the execution status of the application. There are two different interfaces supported: text-based and graphical. The text-based interface indicates the time a module starts executing including the machine being used for the execution. As a module finishes execution, this fact is also dynamically noted. The graphical interface is available only for visually specified applications and uses a pre-determined color-scheme to indicate modules which have finished execution, are currently executing and have finished execution.

5 Conclusion

In this paper, we have described a integrated Web-Java based environment, Arcade, for the design, execution, monitoring and steering of heterogeneous applications in distributed execution environment. We have described the overall goals of the system We have described the current prototype of the system which is capable of executing distributed applications on a network of resources in a single domain. We are currently

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expanding the system to incorporate all the facilities envisioned in our architecture in a phased approach, an approach where the driving force is the user of the system. In particular we are focussing on issues such as resource mapping and scheduling, security, and interoperability with other systems. More information on the Arcade system can be found at http://www.icase.edu/arcade.

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References

[Beca et al. 1999] Lukasz Beca, Gang Cheng, Geoffrey C. Fox, Tomasz Jurga, Konrad Olszewski, Marek Podgorny, Piotr Sokolowski, Tomasz Stachowiak, and Krzysztof Walczak. "TANGO - a Collaborative Environment for the World-Wide Web," http://www.npac.syr.edu/projects/tango.

[Bhatia et al. 1997] Bhatia, D., Burzevski, V., Camuseva, M., Fox, G., Furmanski, W., and Premchandran, G. "WebFlow-a visual programming paradigm for Web/Java based coarse grain distributed computing," *Concurrency: Practice and Experience* , Java Special Issue, vol 9(6), March 1997, pp 555-578.

[Burnett & Baker 1994] M. Burnett and M. Baker. "A Classification System for Visual Programming Languages," Technical Report 93-60-14, Department of Computer Science, Oregon State University, Corvallis, OR 97331, 1993 (revised 1994).

[Chen et al. 1997] Z. Chen, K. Maly, P. Mehrotra, P. Vangala and M. Zubair. "Web-based framework for Distributed Computing," *Concurrency: Practice and Experience* , Java Special Issue, vol 9(11), November 1997, pp 1175–1180.

[Goldman et al. 1995] K. J. Goldman, B. Swaminathan, T. Paul McCartney, M. D. Anderson, and R. Sethuraman. "The Programmers' Playground: I/O Abstraction for User-Configurable Distributed Applications." IEEE Transactions on Software Engineering, 21(9):735-746, September 1995.

[Gray & Sunderam 1997] P. Gray and V. Sunderam. IceT: Distributed Computing and Java," *Concurrency: Practice and Experience* , Java Special Issue, vol 9(11), November 1997, pp 1161–1168.

[Maly et al. 1994] K. Maly, S. Kelkar and M. Zubair. "Scientific Computing using pPVM," *International Conference on Parallel Processing*, vol 2, pp. 201 - 205, August 1994.

[MPI 1997] Message Passing Interface Forum. *MPI: A Message-Passing Interface Standard Version 2.0* Technical Report, Computer Science Department, University of Tennessee, Knoxville, Tennessee, 1997.

[Habanero 1999] NCSA Habanero Project, http://www.ncsa.uiuc.edu/SDG/Software/Habanero/.

[Orfali & Harkey 1997] R. Orfali and D. Harkey, "Client/Server Programming with Java and CORBA", John Wiley & Sons, 1997.

[Midas 1999] J. C. Peterson. "Multidisciplinary Integrated Design Assistant For Spacecraft (MIDAS)," http://mishkin.jpl.nasa.gov/Midas_Page.

[PRE 1999] "Product Realization Environment," http://www-collab.ca.sandia.gov/pre.

[Sunderam 1990] V. Sunderam. "PVM: A Framework for Parallel Distributed Computing," *Concurrency: Practice and Experience*, Vol 2 No 4, December 1990.

[Weston et al. 1994] R. P. Weston, J. C. Townsend, T. M. Eidson and R. L. Gates. "A Distributed Computing Environment for Multidisciplinary Design," *5th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization*, Panama City, FL, AIAA 94-4372, September 7-9, 1994.

Spatial-Semantic Virtual Worlds: The Structural Duality and Beyond

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Abstract: The situated nature of social interaction often highlights the interplay between the structure of discourse and the surrounding environment. We introduce the concept of structural duality in order to capture the nature of social dynamics in spatial-semantic virtual environments. The concept of structural duality is developed with reference to the use of a spatial-semantic virtual environment called StarWalker. The spatial-semantic model in StarWalker extends the traditional notion of spatial models and emphasizes a tighter coupling between social interaction in the foreground and the shared content in the background. Such virtual environments not only allow users to access a shared space to communicate with each other, but also provide contextual resources as an integral part of a virtual place for focused social interaction.

1. Introduction

Studies of social dynamics have shown that people draw substantial information from their surrounding environments and incorporate such information into their conversation in a specific social context. Such information often highlights significant aspects of the social context and enables people to communicate with each other effectively.

Bowers et al. analyzed the process of a virtual meeting held within a multiuser virtual environment [Bowers et al. 1997]. They concluded, "the overall design of virtual worlds should be considered in terms of how they afford social interaction and not just in terms, say, of their navigability, capability for presenting masses of information, or their thrilling aesthetics."

StarWalker is a spatial-semantic virtual environment designed to afford and forge social interaction [Chen 1999a; Chen et al. 1999]. It integrates semantic visualization models of a specific subject domain into a multiuser virtual world. The spatial-semantic model in StarWalker extends the traditional notion of spatial models and emphasizes the situated nature of social interaction in a virtual environment and a tighter coupling between social interaction in the foreground and the shared content in the background. The shared visualization model is a key design component of StarWalker. It functions as a referential resource for users to draw information regarding the nature of a specific virtual environment. In such virtual environments, not only can users communicate with each other in real time over distributed computer networks, but they can also use the shared semantic model as a starting point to build a common ground.

Spatial navigation originally refers to navigation guided by geometric or topological properties of a virtual or the real world, for example, sailing in the sea or travelling in a city. Semantic navigation is more abstract. It refers to navigation in which people choose destinations and follow pathways in an abstract world. Such navigation is guided by the semantics associated with a destination and connecting paths. Browsing a conventional hypertext or surfing on the WWW is a classic example of semantic navigation.

In contrast, social navigation refers to a navigation and search strategy commonly used in the real world. People from time to time follow like-minded peers in places such as museums, galleries, and theme parks. The design of StarWalker aims to provide an intuitive medium for people to navigate together in a complex information space and foster social navigation in a virtual environment. Focusing on foraging and affording focused social interaction in StarWalker has led to an integration of spatial, semantic, and social navigation at a deeper level. Our ultimate goal is to build a persistent, evolving, and domain-specific virtual environment as a forum and a resource shared by a community of professionals and users interested in the underlying subject domain.

In this paper, we will introduce the concept of structural duality and illustrate it with examples of the use of StarWalker. In these examples, we are particularly interested in the tension between discourse structures in the foreground and the shared semantic structure in the background. Such virtual environments will allow users to communicate with each other not only *in* a shared virtual space, but also *through* a virtual place with additional contextual cues.

2. Spatial Models

The increasing popularity of spatial models in the design of virtual environments is largely due to their simplicity and intuitiveness. MASSIVE is a good example of using a spatial model of interaction in a virtual environment [Greenhalgh & Benford 1995]. In MASSIVE, each user is represented by a simple avatar. Each avatar is surrounded by a "personal sphere" — an aura. Interaction between users is controlled in terms of spatial interrelationships among these auras. Users can communicate as long as their auras are in touch, or overlapped. MASSIVE also provides two other concepts called focus and nimbus in order to represent the attention and influence of a user in a spatial model.

The analysis of Bowers et al. highlighted some problems with a self-selected turn-taking process in a virtual meeting within MASSIVE [Bowers et al. 1997]. They emphasized that affordances of the virtual world for social interaction and the availability of non-verbal communication channels may all contribute to the identified problems.

Harrison and Dourish challenged the role of spatial models in virtual environments [Harrison & Dourish 1996]. They distinguished the notions of space and place, and argued that it is place, rather than space, that fosters and shapes social interaction. What distinguishes place from space is the critical property that establishes the sense of context and appropriate behavior within this context. In a place, people draw various cues and adapt their social behavior to their surroundings.

3. Social Navigation

Dourish and Chalmers introduced social navigation as one of the three major types of information seeking strategies [Dourish & Chalmers 1994] . The other two are spatial navigation and semantic navigation as explained in previous sections. Social navigation, they claim, is information seeking by following the trial of like-minded individuals in an information space.

Dieberger also used the term social navigation in association with the use of read wear in a Web-based MOO [Dieberger 1997]. The concept of read wear mimics the worn of a book and indicates how often it was read in the past [Hill et al. 1992]. Dieberger incorporated the idea in a MOO by showing how frequently an exit was used by previous users. Similarly, Wexelblat's Footprints system visualizes users' paths of accessing a website [Wexelblat 1997]. A key aspect of social navigation here is the development of search heuristics based on other people's search history or their current behavior.

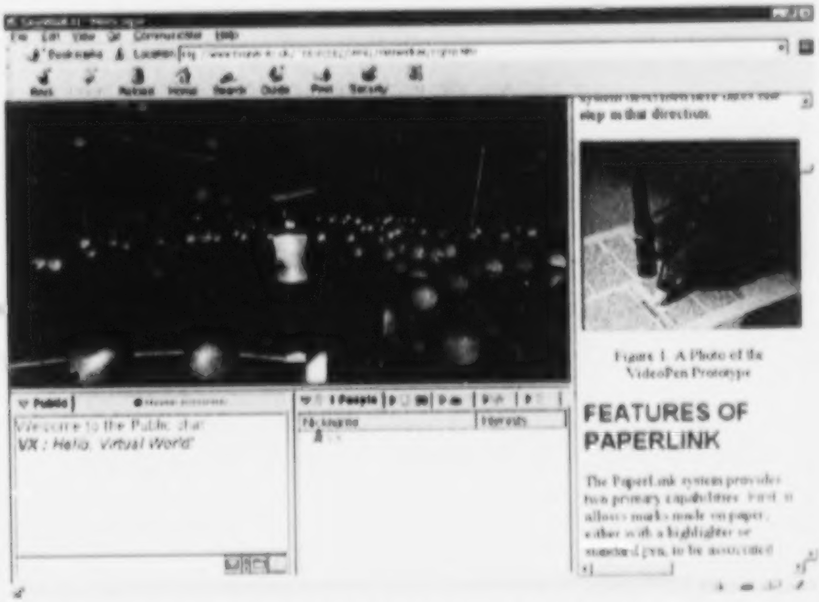
An appealing approach to fostering social interaction in a virtual environment is to establish a tighter coupling between spatial and semantic aspects of the same virtual environment. By connecting semantic significance and relevance closely to spatial positioning and movements of embodied users we are able to attach significant meanings to the trial of peer users. Such value-added meanings can be used not only to improve the effectiveness of social navigation, but also to afford more focused and direct social interaction.

4. StarWalker

The design of StarWalker closely combines spatial and semantic metaphors in order to establish an intuitive virtual environment for social navigation. An ultimate goal is to transform a virtual environment into a forum as well as a resource of the literature concerning specific scientific communities. The current prototype is available on the Web through blaxxun's Online Community client browser plug-in.

StarWalker's user interface consists of four areas: a virtual world window, a chat window, a content window, and a status window [Fig. 1]. Design details can be found in [Chen 1999a]. In StarWalker, users can perform the following tasks:

- talk in public or private through text- and audio-based chat facilities,
- navigate through the 3D virtual world,
- move to pre-defined viewpoints in the virtual world,
- meet other users through avatar embodiment,
- view the full content of a document on the Web,
- migrate to other virtual worlds,
- generate virtual landscapes in response to ranked search results (restricted to internal users)



step in that direction.

Figure 1. A Photo of the VideoPen Prototype

FEATURES OF PAPERLINK

The PaperLink system provides two primary capabilities. First, it allows marks made on paper, either with a highlighter or standard pen, to be associated

Welcome to the Public chat

VX : Hello, Virtual World

Figure 1: The user interface of StarWalker, consisting of four component windows.

Upon entering StarWalker, the user will see a landscape view of the semantic structure. There are a number of ways that users can move around within this VRML-based virtual world. Typically, one can walk or fly, or move directly to a predefined viewpoint. StarWalker currently provides several viewpoints from various perspectives, including an overview, various landscape views in different directions, and a galaxy view. If several people visit the same virtual world, they can see other users' avatars in the same virtual world.

The most special component of StarWalker is the virtual reality model embedded in the virtual world. This model visualizes some latent structures of an underlying data set. A number of visualization schemes have been developed under a generic visualization framework called Generalised Similarity Analysis (GSA) [Chen 1998a; Chen 1998b; Chen 1999b].

The prototype described in this paper is based on a semantic visualization derived from three ACM SIGCHI conference proceedings (1995-1997). Links between spheres represent the strongest semantic relations between corresponding papers. Technical details regarding the visualization can be found in [Chen 1998a; Chen 1998b; Chen 1999b]. In essence, the visualization used a special type of associative networks known as Pathfinder networks. The major advantage of Pathfinder networks is that they represent salient semantic structures with the least number of links. The resultant network is usually a concise representation of structural patterns in the original data. This model was subsequently rendered into a spatial-semantic model in Virtual Reality Modelling Lanuage (VRML).

5. Structural Duality

Research in virtual environments, especially textual virtual environments such as MOOs, has addressed the question of how a virtual environment as a medium shape conversations [Erickson 1997, Toomey et al. 1998].

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For example, Erickson analyzed how people communicate in Cafe Utne, one of the busiest Web conferencing communities on the Internet [Erickson 1997]. Cafe Utne is built on a metaphor of a place where people come, and find conversations of their interests. Erickson found that the social pressures for participation, often found in face-to-face participation, are missing in the virtual discourse medium. He concluded that mutual awareness would be an important factor that may shape the discourse in such virtual environments.

There are many potentially useful methods for the study of structural duality, for example, Conversation Analysis (CA), Frame Analysis (FA), and Interaction Process Analysis (IPA) [Bales 1951]. In this paper, we will only outline how IPA can be used to detect the structural duality in StarWalker.

IPA is a well-known model of group dynamics in a face-to-face meeting. According to this model, the focus of a meeting shifts back and forth between tasks and social-emotional needs among participants. This model suggests the existence of dual processes between tasks-oriented episodes and social-emotional ones in face-to-face meetings.

According to IPA, the shift of attention is caused by the tension between tasks and social-emotional needs among participants. When attention is given to the task, strains are created in the social and emotional relations of the members of the group, thus the attention turns to these problems. So long as the group devotes its activity simply to social-emotional activity, however, the task is not getting done, and attention would be expected to turn again to the task area [Bales 1951].

This model provides a reference framework for us to explore the concept of structural duality in a spatial-semantic virtual environment. One may seek answers to several significant questions regarding the structural duality. For example, what patterns can we find regarding cross-episode transitions in social interaction within StarWalker? What factors cause cross-episode transitions? Are they related to the spatial-semantic coupling in the virtual world?

6. Structure of Dialogues

The concept of structural duality was studied by analyzing the transcripts of several conversations in StarWalker. In particular, we focus on two aspects of social interaction within the virtual world:

- the intrinsic dynamics of the discourse;
- the relationship between the discourse and the semantics of the virtual world.

This preliminary analysis of discourse dynamics was largely based on IPA's high-level model. We intend to conduct further studies at deeper levels. Our central question is whether the virtual environment affords social interaction.

The following analysis is concerned with casual dialogue in public sessions in StarWalker. The aim was to find out to what extent the course of a conversation was shaped by the spatial metaphor. The analysis particularly focused on the following questions:

Why do people visit the StarWalker virtual world?
What do they talk about in StarWalker?
What do they think of the overall organization of StarWalker?
What is the most interesting feature to them?
What do they think of the semantic network?

Most visitors have been regular users of the blaxxun's Online Communities. They tend to be interested in meeting people and curious to explore a new virtual world. The spatial-semantic metaphor of StarWalker evoked several episodes about the spatial layout and its meaning. Many people thought the semantic model was a molecule. One visitor said "*It is the DNA for me as an avatar and the VR-universe!*" Some users thought it was a star map. Some others thought it was to do with Star Trek or some spaceships.

The transcripts show that StarWalker clearly gave users a strong feeling that it is considerably different from other virtual worlds that they have visited — it represents an abstract world. Unlike many virtual worlds structured based on buildings, cities, and natural landscapes, StarWalker offers a new model of interaction beyond a simple spatial model. For example, a visitor referred to the place as an inner space.

> I saw it on the list and never been here. StarWalker sounded interesting, but instead of going to outer space I came into inner space ;-)

In another example, one visitor asked if this place is only for *trekkies* — Star Trek fans. Users were concerned if their social behavior would fit the constraints implied by StarWalker. Of course, a similar question may rise in a more conventional virtual world such as a virtual world called Mars in Active Worlds. What is special to

StarWalker is the combination of an abstract world and the multi-user avatar embodiment [Fig. 2]. The development of StarWalker broadens the range of 3D virtual environments. As one user said

> I have not seen any multiuser environment this abstract before... I always thought the communities looks too much like the "real" world...

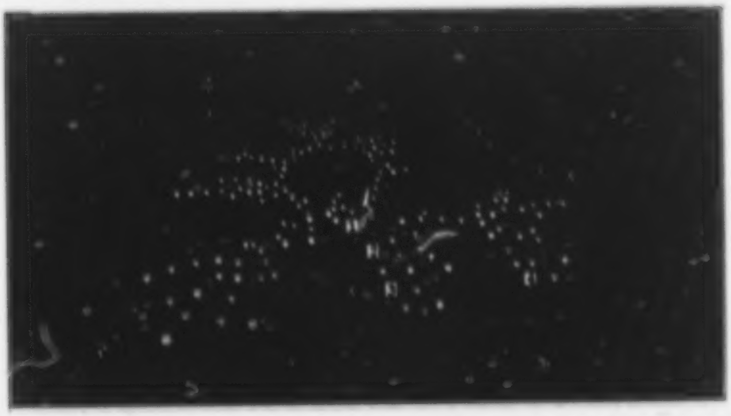

Figure 2: Social navigation in StarWalker is viable by following the trails of avatars

Much of the conversation in the public session was related to the semantic or spatial organization of StarWalker. In parallel, participants engaged in some informative discussions about their interests. Our experience in StarWalker and other 3D virtual worlds such as Active Worlds and blaxxun's Online Community seems to suggest that the overall spatial-semantic metaphor of StarWalker enabled people to maintain interesting and more focused conversations than other general virtual worlds.

7. Conclusions

In this paper, we have introduced the concept of structural duality and illustrated the concept with a spatial-semantic virtual environment called StarWalker. The fundamental design principle of StarWalker is to combine an abstract virtual world with a multi-user avatar embodiment. This combination will allow users to follow the trails of peer users, i.e. to enable social navigation. Ultimately, a tighter coupling between spatial and semantic aspects of a virtual environment will bring more focused and direct social interaction into the virtual environment. The structural duality between discourse structure and the content of the embedded abstract world provides an analytical framework for us to assess the impact of a virtual environment. The concept of structural duality also provides a theoretical basis for the development of spatial-semantic virtual environments. This theoretical basis will be invaluable to consolidate the convergence between interdisciplinary communities such as information visualization, virtual reality, and computer mediated communication.

Embedding an abstract world into a 3D multi-user virtual environment is only the first step to afford social interaction. Much work is needed to develop more adequate models of interaction and behavioral semantics and to accommodate various integral aspects of a virtual environment in harmony, including spatial, semantic, social, ecological, and cultural implications.

StarWalker demonstrates a generic approach to the development of virtual environments, with potential applications in areas such as shared digital libraries, collaborative learning, and virtual conferences for special interest groups and virtual communities. A tight spatial-semantic coupling provides a good starting point for us to explore the structural duality further between social interaction in the foreground and an abstract virtual world embedded in the background.

A great challenge for the future work is how to link the concept of structural duality with observable patterns of social interaction in StarWalker or similar virtual environments. So far StarWalker has attracted many visitors and forged many interesting conversations. On the other hand, the majority of the conversations in general focused more on the spatial aspect of StarWalker than its semantic counterpart. In a recent experiment, three users had a brainstorming session within StarWalker in order to determine the topic of an article they were asked to write together [Chen et al. 1999]. This experiment started to reveal a tighter coupling between spatial and semantic aspects from the point of views of users. On the other hand, the majority of conversations in StarWalker focused on the spatial aspect of StarWalker rather than its semantics.

We plan to undertake empirical studies, including comparative studies across small group discussion sessions in virtual worlds with different spatial layouts and semantics. We also plan to have larger-scale studies within StarWalker. We intend to study the structural duality across a wider range of settings, such as asynchronous and synchronous discussion groups, textual and virtual-reality-enabled virtual environments. Our aim is to develop virtual environments that can afford social interaction and help people to establish a common ground for both social interaction and task-oriented activities.

8. References

[Bales 1951] Bales, R. (1951). *Interaction Process Analysis*. Cambridge, MA: Addison-Wesley.

[Bowers et al. 1997] Bowers, J., Pycock, J., & O'Brien, J. (1997). *Talk and embodiment in collaborative virtual environments*. Proceedings of CHI'97 .

[Chen 1998a] Chen, C. (1998a). Bridging the gap: The use of Pathfinder networks in visual navigation. *Journal of Visual Languages and Computing, 9*(3), 267-286.

[Chen 1998b] Chen, C. (1998b). Generalised Similarity Analysis and Pathfinder Network Scaling. *Interacting with Computers, 10*(2), 107-128.

[Chen 1999a] Chen, C. (1999a). *Information Visualisation and Virtual Environments*. London: Springer-Verlag London.

[Chen 1999b] Chen, C. (1999b). Visualising semantic spaces and author co-citation networks in digital libraries. *Information Processing and Management, 35*(2), 401-419.

[Chen et al. 1999] Chen, C., Thomas, L., Cole, J., & Chennawasin, C. (1999). Representing the semantics of virtual spaces. *IEEE Multimedia, 6*(2), 54-63.

[Dieberger 1997] Dieberger, A. (1997). Supporting social navigation on the World-Wide Web. *International Journal of Human-Computer Studies, 46*, 805-825.

[Dourish & Chalmers 1994] Dourish, P., & Chalmers, M. (1994). *Running out of space: Models of information navigation*. Proceedings of HCI '94 .

[Erickson 1997] Erickson, T. (1997). *Social interaction on the net: Virtual community as participatory genre*. Proceedings of the 30th Hawaii International Conference on Systems Science (pp. 23-30), Hawaii, HA.

[Greenhalgh & Benford 1995] Greenhalgh, C., & Benford, S. (1995). MASSIVE: A virtual reality system for tele-conferencing. *ACM Transactions on Computer Human Interaction, 2*(3), 239-261.

[Harrison & Dourish 1996] Harrison, S., & Dourish, P. (1996). *Re-place-ing space: The roles of place and space in collaborative systems*. Proceedings of CSCW '96 (pp. 67-76), .

[Hill et al. 1992] Hill, W. C., Hollan, J. D., Wroblewski, D., & McCandless, T. (1992). *Edit wear and read wear*. Proceedings of CHI'92 Conference on Human Factors in Computing Systems (pp. 3-9), Monterey, CA.

[Toomey et al. 1998] Toomey, L., Adams, L., & Churchill, E. (1998). *Meetings in a virtual space: Creating a digitial document*. Proceedings of the 31st Annual Hawaii International Conference on System Sciences (pp. 236-244), Hawaii, HA.

[Wexelblat 1997] Wexelblat, A., & Maes, P. (1997). *Visualizing histories for Web browsing*. Proceedings of RIAO'97: Computer-Assisted Information Retrieval on the Internet Montreal.

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Streaming Media for Web Based Training

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Abstract: Streaming audio became available on the Web in 1995, but with the development of the Synchronized Multimedia Integration Language (SMIL)[1], the technology has reached a new level of maturity. SMIL is based on the XML standard, and allows audio, video, images, and text to be integrated. The implications for Web based pedagogy are tremendous. We now have the opportunity to do training on the desktop in a feature-rich open environment. We will give a basic background in streaming media technology, discuss the standards, the current state of the art, our experience with RealNetworks [2], how to take advantage of it in an intranet environment, and touch on future developments, including the integration of testing engines.

Taking Web Based Training into the 21st Century

In the online world of 1999, what you can do is both empowered and constrained by the technology. A good understanding of the limits of the viewing software, end user hardware, and intervening network allows the instructional designer to make the best possible use of what is available - to push the limits while balancing speed and usability. We are now entering a new world where those limits are being pushed back rapidly, and anything is possible. It is still very important to understand the limits, for now, but it is equally important to break down our preconceived notions of what is possible. For a moment, imagine anything is possible!

The new SMIL (Synchronized Multimedia Integration Language) standard allows multimedia content, including text, pictures, sound, and video to be synchronized for a coherent learning experience. Control of all these media is contained in a simple text file (although the format is quite complex). Tools to simplify creation and editing are rapidly being developed. SMIL can greatly reduce the bandwidth required while delivering an experience similar to watching a fully interactive television channel.

Definitions, History, and Current Status

Streaming media is defined as network based data, which can be presented to the user before the whole data file has finished transferring. If you see a picture begin to appear on your screen before the transfer completes (e.g., a PNG or some JPG files), or hear an audio file start playing as soon as you click it (e.g., a RealAudio file), that is an example of streaming media.

The primary advantage of streaming is that large audio and video files can be played as they arrive on the computer rather than having to wait for the file transfer to complete. For training in particular, this means that the user interface is much more responsive.

Data can be streamed in a variety of ways:

	Pre recorded / on-demand	Real-time / on-demand - pulled	Real-time / live - pushed
Web server	✓		
RealMedia™ server	✓	✓	✓

If served via the web server, when a user clicks on a web link to a RealAudio sound file, the data is delivered over the web's HTTP protocol. One kind of data can be presented. If served via the RealMedia server, the data is delivered back to the web browser via a streaming protocol like RTSP (Real Time Streaming Protocol) or UDP. Pre-recorded content could include online training materials, and real time content could include classes and meetings.

SMIL is important for several reasons. First, it integrates various kinds of media. Second, it is an open standard that can be leveraged across all platforms. Finally, it is derived from the W3C Extensible Markup Language (XML)[3] standard; this is important because anything can be defined in XML, and it can be extended on the fly simply by defining new tags.

A SMIL player can act like any other Web browser plug-in, and display SMIL content over an HTTP connection. However, it can also subscribe to a host group and view an IP multicast, or negotiate the control connection and open a unicast RTSP connection to stream the data.

The TCP/IP protocol upon which the Internet is based is reliable over a wide variety of physical networks because the packets can be retransmitted by TCP, the Transmission Control Protocol. [4] When delivering streaming data over a high bandwidth corporate or university campus network, however, the high reliability of TCP is not required, and retransmissions can slow down performance and take up too much network bandwidth. RTSP is designed to degrade gracefully even if a few packets get lost, and therefore delivers the data faster with lower overhead. Early papers on Real-Time Video concluded that the Web was not suitable for high bandwidth media, because of the inherent delays. [5] The new protocols help deal with these problems.

With IP multicast, a streaming server can send a broadcast message across the network, allowing multiple computers to receive it. The new protocols can allow some packets to expire without retransmission, and new routers can allow the data to go across the network to multiple destinations with only one destination address, the multicast host group address, in the header.

If you want to take advantage of these capabilities, first decide on your needs, then take the time to understand the options. You can then talk with your networking group for help in configuring routers, or to help you decide what technology best suits your needs.

SMIL, the best direction for Web Based Training

Just as web based training (WBT) has some important gains over traditional classroom training, the use of SMIL allows the Instructional Designer (ISD) to take the training experience one step further. SMIL builds on the existing base of XML standards, tools and experience. It allows for very easy indexing and editing because the control files are all plain text with tags, similar to HTML. It can be used inline within an HTML page, and allows simple extensibility for other applications (such as testing engines) within a well-defined framework. Open standards tend to be simple and durable.

Poorly designed WBT can be a waste of time and money as well as an ineffectual tool for training. Many of the streaming videos foisted upon unsuspecting viewers as WBT show a video of a slide presentation with an audio narration, or even worse a subject matter expert as a "talking head" giving a lecture. To take advantage of SMIL, build a presentation including the audio track of the lecture combined with streaming text of the speaker's notes, streaming JPEGs of any presentation slides, and perhaps short video segments of any animated processes required to illustrate the topic. Besides being more informative and imminently more useful to the end-user, the performance gains of the SMIL presentation over the pure video are tremendous. The network bandwidth required for audio playback audio with text and JPEGs can be less than half that of a single video stream. Due to the fact that the JPEGs will take up less bandwidth than the video, the quality of the JPEGs can be much higher and small details on the presentation slides, like text, will actually be readable by the end-user. The audio and text tracks could be localized and presented to the user in the language of their choice without having to re-author the entire presentation in a single monolithic chunk. SMIL gives you the ability to split these data types into separately maintained files and maintain full control over how and when they are displayed to the user. One of SMIL's strongest abilities is controlling when something happens on-screen. The content author can precisely control all events, effects and transitions.

Applications that support open standards tend to be available at low or no cost for academic uses. Many of the instructional design tools available today use proprietary code and custom designed Java plug-ins to display the coursework. Some software companies charge far too much for their WBT solutions and may have simply repackaged their custom computer-based training software engines into a complicated browser plug-in. Using this type of approach to WBT can lead to a variety of problems. Trying to deploy the specialized plug-ins to your client base and dealing with unforeseen incompatibilities caused by these plug-ins can quickly become a maintenance nightmare. Better to rely upon a solution based on open standards where the browser plug-ins are freely available and tested by the Internet at large.

There are still some issues to be resolved with SMIL. Drag-and-drop tools to automatically generate SMIL code are still in their first-generation or in beta testing. Complex SMIL presentations still require hand-coding or at the very least, some hand tweaking to perfect and debug. At the time this paper was authored, writing SMIL presentations complex enough to be called WBT requires knowledge and experience beyond the capabilities of the typical instructional-designer. For now, the use of an experienced web site programmer or a staff member who can be dedicated to learning the technical aspects of SMIL is recommended.

From an authoring standpoint, the emerging collaboration and streaming technologies in Microsoft Office 2000 appear to be simple to use and well integrated into the traditional Office suite of tools. It remains to be seen if the Microsoft products continue to have the server scalability and quality issues which plagued earlier streaming technology releases.

When choosing a streaming technology for WBT many factors must be weighed and evaluated. There are a variety of technical factors such as existing network infrastructure between you and your audience, server platform and availability, and client software maintenance. These will be discussed in "The Real Nitty-Gritty" section below. Other factors, which can sometimes be more important to overcome than the technical issues, include personal experience and comfort level with the technology, institutional politics, and any existing corporate relationships. First and foremost, you need to be comfortable and familiar with the technology you implement. If your instructional designers are all familiar with a specific tool set and very comfortable with the processes and procedures surrounding your existing traditional or CBT training methods, there will probably be a substantial resistance to change. Overcoming any internal training paradigm "inertia" will definitely be an obstacle. Often, training the trainers is the hardest job of all. Convincing the management that a new method of training is needed and it may cost them some money to overcome the technical issues can sometimes be an insurmountable hurdle. Presenting the idea to management requires careful analysis of the actual costs involved. Another potential issue when choosing a streaming technology within an organization can be factoring in any pre-existing corporate relationships. If your organization has, for example, a strong relationship with Apple Computers, then trying to justify a WBT solution utilizing SMIL instead of QuickTime for streaming media may require good analysis and strong justifications.

The Real Nitty-Gritty

Building a WBT module using SMIL follows the same process as building traditional WBT with a few specialized requirements. The first phase of any project is the conceptual brainstorming and storyboarding. This is best done on paper for speed and easy reference. The first step is to define the objective of the WBT module. Decide what information is to be conveyed to the viewer and be specific. Define the project scope, setting definite boundaries encompassing just enough detail to properly cover your objectives. Keep the focus tight and stick to your stated objectives. Next, set requirements for the user experience, thinking about not just what the user will be learning, but how you want them to learn. The idea is to lead them through your learning materials in an organized and straightforward manner. This will help you design the navigational methods used within the WBT module. Try to design the framework first. Don't worry about the graphics yet, work on the layout first. Designing a common look-and-feel that can be reused across modules will help reduce development time on subsequent projects and lend a consistency to your training. Consistent look-and-feel across WBT modules gives the viewer a higher comfort level knowing that even though the subject matter may be new, the process of learning throughout your modules is familiar.

From your storyboard, build a timeline and organize the presentation of your learning materials. Plan the layout of the learning materials and the navigational items. Decide when a particular item needs to be displayed. This will help you determine load orders of your media assets and help identify any constraints imposed on your load order by your target bandwidth. With SMIL different items within your presentation can be specified to load serially or in parallel. It's usually a good idea to make sure that your navigation buttons and other graphics and text load before the user gets to view the video animation on the first page of your presentation.

After the layout and storyboard have been finalized, the next two steps for building your presentation are the design of the interface and the content design of the learning materials. These steps frequently happen in parallel. While one group of graphics artists work on the backgrounds, buttons, graphics and other window dressing, the instructional designers work with the media production staff to plan and create the learning materials.

Interface Design

When designing the interface for SMIL presentations, one must consider how the presentation will be displayed. SMIL can be embedded into a web page or displayed stand-alone in the RealPlayer®. The choice can be simple depending on the level of integration desired, use of any courseware testing engines, and finally personal preference. Either way, standard web design rules definitely apply. To be effective, the interface must be clean and uncluttered. The design should encourage the user to explore while intuitively leading them safely through the learning materials in the appropriate order to effectively teach them what they need to know. The design must support the learning materials. Layout of the presentation should lead the user to focus on the learning materials. With time-based control over all display elements, SMIL provides the ultimate in design flexibility.

As with any web based design project, the module must be designed with the lowest common denominator client system in mind. If your audience is within your organization's intranet and there are hardware and software standards in place to assure that all of your users have at least a certain minimum configuration then it is relatively simple to plan your WBT module to fit within those requirements. Typically, a SMIL presentation should be designed to fit within a 640x480 VGA screen. Remember that the actual usable space within a browser is smaller than the full screen resolution. For a 640x480 VGA display with the web browser window maximized, with default menu settings, the usable screen real estate is approximately 600x300 pixels. When adding a 320x240-pixel video, not much room is left vertically for titles and text.

Learning Materials Content Design

While the graphics artists are busy with the interface, the source materials for the video, audio, and other media clips must be recorded and encoded. Plan and conduct source material recording sessions. Once the project storyboard and layout are finalized, it's time to build the actual "meat" of the presentation. Successfully planning and producing the actual presentation material is simple if you, the designer, have control over the material being presented. More often than not, the audio and video have to be recorded onto cassette or videotape and then digitized and encoded for use on the web.

When dealing with video as a streamed medium, many factors influence the final stream quality and playback rates. The well-known rule of "Garbage in, garbage out." applies to streaming video. The higher the quality of the recording used as source material, the smaller and faster the streaming video file will be. The differences in signal-to-noise ratios and overall resolution between VHS, S-VHS, 8mm, High-8, Mini-DV, BetaCam-SC, and DV-PRO video formats (these are listed in increasing degree of quality) directly influence the playback frame rate and encoded file size of the streaming video file. The better the format you can afford to record in, the cleaner and better your video will stream to your clients.

For important high-bandwidth content, the use of a professional video production staff equipped with proper lighting and recording equipment will always yield a higher quality recording than a consumer-quality video camera. This by no means should be interpreted to mean that low cost, consumer-quality equipment is incapable of producing satisfactory results. However, to provide Internet-based video streams larger than a postage stamp at acceptable quality when network bandwidth is at a minimum, starting with premium quality video recordings is essential. The objective here is to plan the multimedia source materials appropriately taking into consideration the time, resources, and funding required to realistically achieve your design goals.

Building the RealText™, RealPix™, and SMIL files

After the actual content files have been created, the SMIL presentation files need to be created. This is quite similar to creating HTML pages, except SMIL is time sensitive and requires specific timing for each event and transition, and the files need to live on the streaming server, not the web server. For instructions on how to code SMIL files, the SMIL technical documentation can be found at the World Wide Web Consortium Architecture for Synchronized Multimedia [1].

Technological Issues

The topics covered within this section will address issues surrounding manufacture of streaming media for intranet use where high-bandwidth network connections are available. Although SMIL presentations can be adapted to incorporate different sized videos for either high or low bandwidth use, that is outside the scope of this paper.

Once the instructional designer has obtained the source materials for the videos, they need to be digitized. The format into which the video is digitized will affect the final encoded output. Always digitize video uncompressed at 30 frames per second and in Stereo at 16-bit 44-KHz sampling rates. Let the streaming format encoder software have the best quality input so it has the all of the data it needs to provide the highest-quality output. The more data the encoder has to work with, the fewer assumptions the compression routines need to make. This will result in smoother, cleaner, and smaller encoded video output.

Digital editing of video and audio sources before encoding is usually required. Certain optimizations such as video cropping and audio normalization can be made to provide optimal output upon playback. Applications for video and audio editing include Adobe Premiere® and Sonic Foundry's SoundForge®.

Encoding content to RealNetworks formats

Audio and video can be encoded into the RealNetworks® RealMedia® format using a variety of third party applications. The easiest encoder to use is the RealProducer® Plus G2 from RealNetworks. It has many different stream options. The RealMedia G2 SureStream™ format option allows multiple streams at different bandwidths to be encoded into the same file. This allows the RealPlayer® and RealServer® to better negotiate how much data to send the player based on network performance. For example, a video may be encoded for 28.8K modem, 56K modem, 64K Single ISDN, 128K Dual ISDN, 220K xDSL and Cable Modem, and 150K Corporate LAN data rates all within a single file. Depending on the available network bandwidth, the player will switch between these different encoded formats dynamically as the user watches the video. This feature provides much better playback than older streaming technologies, which only adapt to changing network conditions by dropping frames or "fuzzing-out" the video into large indistinguishable blocks. Depending on the resolution and frame rate of your video source files it may not make sense to encode at the higher bandwidth settings, such as 220K and 150K, and at the low bandwidth settings, 28.8K, 56K, and single ISDN in the same file. The lower settings may not have enough available bandwidth to stream the file.

Streamed animations can be produced using Macromedia's Flash® technology. Flash is in widespread use for non-streamed web based animations. The same animations can be included into your SMIL presentation after a simple encoding procedure into the RealFlash™ format. Now the use for Flash animations is no longer limited to the realm of the static web page and can be unleashed into the dynamic environment of a SMIL presentation. The RealNetworks site has some good examples of RealFlash™ SMIL presentations.

Bandwidth between you and your target audience is the limiting factor on SMIL design. Designing SMIL presentations includes tradeoffs for each data stream sent to the player. The designer must balance data stream buffering times versus compression and the number of streams being loaded simultaneously. These calculations are also affected by the resolution of the data to be streamed. Resizing a video originally intended to stream at 320x240 pixels down to 160x120 will reduce your bandwidth requirements by a factor of four (assuming constant compression rates). The RealNetworks SMIL kit has exhaustive information on this topic.

Uploading files to stream server

As the streaming media files are created, they need to be stored on a separate server running the RealNetworks RealServer® G2 server software. The content creator will need to place the files in a subdirectory off the mount point for the server, and will need the address and port number of the server, as well as whether the Ramgen file system, for sending temporary small files, is in use. The files can then be linked to from any web page. Links can be of the format http://server/ramgen/MountPoint/virtual_directory/filename, and once within SMIL, individual components can be specified in a very similar format, rtsp://server/MountPoint/virtual_directory/filename. [6]

Hardware requirements

Hardware requirements vary widely depending on your application. Four sets of hardware requirements are involved: network infrastructure, web server, stream server, and client browser/player. The web server requirements and configuration are outside the scope of this document. Many of the issues discussed here are particularly important to corporate implementers who have controlled environments into which they wish to introduce streaming technologies. The only successful way to implement streaming media in a corporate environment is to work with the network and computer infrastructure organizations within your company to understand and proactively adapt to the additional requirements imposed by the technology.

Network infrastructure: Both Internet and intranet bandwidth demands should not be underestimated. Careful analysis of current network loads and capacities can help determine how much streaming traffic can be handled before network upgrades are required to provide adequate quality of service to all users. Network upgrades are expensive and time consuming. Always consult with your network operations staff before implementing any streaming technologies on a widespread basis across your network.

Client browser/player: The RealNetworks RealPlayer G2 will currently run on any PC-compatibles running Windows 95, 98, NT4.0, and Power Macintosh. Performance will vary depending on CPU speed and available memory. For fast, responsive control and playback, we recommend a minimum of a 166-Mhz Pentium with 32Mb of RAM Slower machines will provide sub-optimal playback. PCs also need to be MPC-2 compliant and have appropriate sound-cards, drivers, and headphones or speakers installed. For corporate intranet sites, overcoming the current installed base of non multi-media equipped PCs can be a significant challenge.

Stream server: The RealNetworks RealServer G2 products run on a variety of UNIX platforms as well as Microsoft NT. Hardware requirements vary depending on expected number of users. Consult the RealNetworks website for details.

Tools

SMIL Authoring	• RealNetworks RealProducer® Pro G2 • Digital Renaissance TAG Author® 2.0 • Veon Interactive V-Active® for RealSystem G2
Audio/Video Editing	• Sonic Foundry's Sound Forge® 4.5 • Adobe Premiere®
Streaming Media Encoding	• RealNetworks RealProducer® Plus G2

Future Directions

Most currently available web based testing software requires custom format files, special software, and is not standards-based. New products such as TopClass [7] use plain text and HTML, and are much better suited to integration within a SMIL framework. Testing is the next step.

The evolution of the tools currently available will no doubt give rise to a suite of powerful and easy-to-use tools for creating SMIL presentations. Ongoing development of SMIL with ratification via W3 will assure interoperability. Better integration and tools will allow the potential we see to be realized. Right now, streaming media is at the level of maturity the web was in 1994. The standards are there, and the tools are coming. You can go out and use the technology now. Let us know what you do with it!

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[1] W3C Recommendation: Synchronized Multimedia Integration Language (SMIL) at http://www.w3.org/AudioVideo/
[2] RealNetworks HTML+TIME at http://www.real.com/
[3] W3C Recommendation: Extensible Markup Language (XML) at http://www.w3.org/XML/
[4] Comer, Douglas E. The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works. Prentice Hall, August 1997
[5] "Real-Time Video and Audio in the World Wide Web" by Chen, Tan, Campbell, and Li. Proceedings of the Fourth International World Wide Web Conference, December 1995.
[6] RealServer Administration Guide at http://service.real.com/help/library/servers.html
[7] WBT Systems TopClass Overview at http://www.wbtsystems.com/

CORBAConnect - Manipulate CORBA Objects via JavaScript

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Abstract: With the technology of the JAVA, we can do even anything on the web browser. It provides a way for the browser to communicate with the server, which provides useful information, and it can access the most up-to-date information or do some client/server job. Unfortunately, using the Java applet in the browser needs a lot of resource to startup the JAVA Virtual Machine and the applets usually do a little job. For an example, a stock quote Java applet only need to retrieve the current stock every few seconds and it's not economic. On the other hand, client-side JavaScript provides a simple way to manipulate client-side objects. In this paper we provide an extension for JavaScript to manipulate server-side CORBA Object. By the way the browser can communicate with the server and use less resource.

1. Introduction

1.1 World Wide Web

The WWW is originally designed for transparent document distribution over the client-server paradigm. Users can get various kind of information distributed worldwide. Information on the net may change from time to time. Some WWW applications encounter a situation that users need the most up-to-date information. It is not easy to do that on the ordinary design of the HTTP [W3C 99a] protocol. Users need to reload the page to get the newest version of the page, which was updated after his last access. To let users access the current information, some systems add an HTML [Raggett et al. 98] tag to notice the browser to reload the content of specific document:

```
<META http-equiv="refresh" content="3,http://www.w3c.org/">
```

The above HTML tag notifies the browser to reload the content specified by the URL after 3 seconds. In this model, users pull the information that they want. It is only a one-way communication; the server even can not push the updated information.

1.2 Java

To do more comprehensive job, Sun Microsystems introduce JAVA [Arnold 96] technology that provides cross-platform feature by using a Java Virtual Machine with special execution file format. With that we can run a small cross-platform program called JAVA Applet on browser and do almost everything. The applet can create a socket connection or retrieve any other information to a server. It is certain that two-way communication is achievable. The major problem of JAVA Applet is the waste of resources. We need both more memory to startup a JAVA Virtual Machine and more CPU time to process JAVA bytecode. On the other hand, Netscape & Sun Microsystems introduced a client-side script named JavaScript. We can embed JavaScript in the HTML to manipulate client-side object with the DOM [W3C 98]. We can pop up an alert window or verify the data entered by the script easily. The combination of HTML, style sheets [W3C 99b] and scripts allows documents to be animated and is called "Dynamic HTML" [Netscape 97] by some vender. Although "Dynamic HTML" is useful and powerful, it can only deal with client-side objects. We can not retrieve any server-side information other than web pages. The JavaScript itself restricts the capability of the JavaScript.

1.3 CORBA

It is a turning point of distributed computing when the object orientation being introduced into the client-server computing paradigm. Communications between clients and servers are now method invocations between objects. Here comes the distributed object [Orfali 95] computing paradigm. The soul of the distributed object computing is the Object Request Broker, ORB, which provides a transparent communication channel between objects. Objects only concern interfaces of the communication peer, i.e. what methods they are interested in, not the communication details, e.g. protocols, media, etc. CORBA [OMG 98, Mowbray 97, Orfali 97a, Orfali 97b], stands for the Common Object Request Broker Architecture, is the representative of the distributed object technologies. Objects in CORBA are described by the interface definition language. They can be implemented in any programming languages on any platforms. This is an important feature of CORBA and makes CORBA be capable of integrating systems in heterogeneous environments.

1.4 New Direction

Combining the powerful information distribution capability of the WWW with the powerful system integration capability of the CORBA would be a good idea. Currently, there are several CORBA vendors provide their WWW solution by allowing JAVA Applet to communicate with CORBA objects. Because the CORBA objects can be implemented by any programming languages, the WWW can integrate with other systems easily through this way. However, this scenario still can not escape from the nightmare of wasting resources. In this paper, we propose a new direction of integrating WWW and CORBA in a more efficient and convenient way. We design and implement a system called *CORBAConnect* that allows JavaScript to manipulate remote CORBA objects. In other words, we appreciate the highly interactive communication between WWW clients and servers, like the JAVA Applet does. In addition, we take fewer rescues because we are scripts. In the following of this paper, we will present our design and implementation of the CORBAConnect system. The potential application of the CORBAConnect will also be mentioned. Finally, we make a conclusion and address our future works.

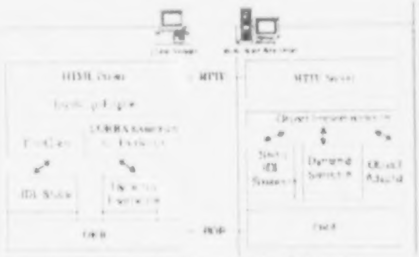

Figure 1. The System Architecture

2. Combining CORBA with JavaScript

2.1 Overview

The basic idea of the project is illustrated by the [Fig. 1]. First, the webmaster designs and implements a CORBA object. Second, the webmaster registers the object to the ORB. The ORB will redirect the client request to the implementation object by a piece of code called *Server Skeletons*. Third, we add some CORBA related classes to the JavaScript Engine. It deals with CORBA objects that are located by the JavaScript through the Dynamic Invocation Interface, DII. The DII allows dynamic use of the CORBA objects without any prior type knowledge of it. Finally, users can view the web pages embedded with the JavaScript. The JavaScript can locate the remote CORBA object and get the object reference. As a result, the script can manipulate the object through the object reference.

2.2 ECMAScript, JavaScript, and Binding

We know that JavaScript is the Netscape-developed object scripting language used in millions of web pages and server applications worldwide. On the other hand, the ECMA Standard [ECMA 98] is based on several originating technologies. The language was invented by Brendan Eich at Netscape and first appeared in that company's Navigator 2.0 browse. It has appeared in all subsequent browsers from Netscape and in all browsers from Microsoft starting with Internet Explorer 3.0. To promote the JavaScript to become an industry standard, Netscape release a version of JavaScript implementation named *JavaScript Reference Implementation* to licensed company to use it as part of their product. The Netscape browser as well as our project are based on this code and extend some kind of classes.

ECMAScript [ECMA 98] is an object-based script: basic language and host facilities are provided by objects, and ECMAScript program is a cluster of communicating objects. An ECMAScript object is an unordered collection of properties each with 0 or more attributes that may contain another object, primitive type data, or a function. Most of our job is defining a class and the JavaScript engine will call some callback functions when the script want to set or retrieve the value of a property. In this paper we focus on the JavaScript 1.1 which is a part of Netscape Communicator 4 and is a superset of the ECMAScript. There are six data types of the JavaScript. The language data type mapping between CORBA and JavaScript of this project is listed in the [Tab. 1].

JavaScript	CORBA	Description
Undefined	-	"Undefined" is undefined in CORBA and will raise an error if the script pass an undefined value to CORBA object.
Null	Object Reference	Null in JavaScript can only be represented the Nil Object Reference.
Number(double)	Double	JavaScript defined a value of double number called NaN (not a number) which will raise a error when the script pass a NaN to CORBA object.
Number(integer)	Short, long, unsigned short, unsigned long, char	The CORBAConnect will convert the JavaScript integer number to proper CORBA data type according the definition of the CORBA Object.
Boolean	Boolean	
String	String	
Object	Object Reference	Only JavaScript object of CORBA Object class can be converted to an Object Reference.
- [Not Implement]	Structured Types: struct, union, sequence, or array	We don't implement these CORBA data types now. We will map them to some type of JavaScript object in future works.

Table 1: Language Mapping between JavaScript and CORBA

2.3 Two-way Communication

With the previous function we described, the JavaScript can access remote object via CORBA, but it's not really a two-way communication. The client can only pull the information from the server by access the attribute or invoke some operation within a CORBA object. How can a server notify a client when the desired data is updated? The obvious way is to let the server program access the object on client-side, but it's not easy to convert a JavaScript object to a CORBA object via *Dynamic Skeleton Interface*. To solve this problem, we design two type of interface, one of them is named *ThinClient*, and the other is named *JS_Object*.

```
Interface ThinClient {
        void OnServerTrigger1();
        void OnServerTrigger2();
        void OnClientTrigger1();
        void OnClientTrigger2();
};
Interface JS_Object{
        void Register(in ThinClient TC);
        void Trigger1();
        void Trigger2();
};
```

The whole browser will provide a ThinClient interface, and the CORBA Objects that want to use the two-way communication feature should inherit the JS_Object interface. When a client want to be triggered by the server side program, the client should register its ThinClient object by the Register operation in the JS_Object interface. And the JS_Object maintains a list of ThinClient object, the server can trigger them and all clients will invoke the method named OnServerTrigger1 or OnServerTrigger2 if it is defined. If one of the clients invokes the operation named Trigger1 or Trigger2 on JS_Object, it will trigger all of the ThinClient 's method OnClientTrigger1 or OnClientTrigger2. In this method, the implementation is easy but useful, we will introduce the use of this method by a simple example in the next chapter.

3. Implementation & Application

3.1 Developing Environment

We integrated the CORBAConnect with the Mozilla Browser, a source code released browser provide by Netscape Communication. The browser is based on the source code of the Netscape Navigator and both of them use the JavaScript Reference Implementation. Thanks to the Netscape Communication for their effort to the OpenSource society.

We also use an ORB named ORBacus [OOC 98] provide by Object Oriented Concepts, Inc. It is free for non-commercial use and the source code is released. Because CORBA is an industry standard and the IIOP protocol, we can use different ORBs between client and server. The ORBacus provides a special operation for ORB, which named *get_inet_object*, we can call the operation to retrieve the object reference in the specific host, port and object name directly. This is a better way then the IOR string to binding.

3.2 Current Status

The current version of the CORBAConnect only supports the attribute and operation within an interface. The "OUT" and "INOUT" types of the arguments are not implemented due to the characteristic of the JavaScript Language. Because the exception is not support in JavaScript 1.1, we do not support it, too. We ignore the exception but provide a global variable named *LastException* which can let the script to know if there raises an exception. We will support exception with the JavaScript 1.4 which built-in the exception feature. In fact, JavaScript with CORBAConnect can access the CORBA Object anywhere, the object implementation is independent with the web server. but security issue is concerned like a JAVA Applet, scripts can only access the CORBA Object on the server where the browser retrieves the web page.

3.3 Application Scenario

Java technology brings everything come true on a browser, but, as we have mentioned previously, it cost much resource. We find three proper situations that the JAVA Applet can used to enhance the web pages:

- **Interactive Graphic User Interface** If you want to open a window for user to input more complex data, to display the news headline in a box like a scroll, or to animate something.
- **Dynamic Information Update** Another situation to use the Java Applet in a web page is that you want some information of this page can be updated dynamically. The most popular application is displaying the stock price. Users can refresh the page by themselves, or refresh it every few seconds automatically. But building a socket communication by a Java applet between browser and the database server is the best way.
- **Collaborative Browsing** An example of the collaborative browsing is chatroom. Many people view the same page and want to exchange their information to each other. Like the situation we discuss previously, you can write a lot of CGI programs or only a JAVA Applet to do this job. Most people will select JAVA Applet to develop such system.

Although JAVA Applet is easy to use, it's is not friendly for user because of it's performance. The JavaScipt is another alternative. in situation 1, we can achieve most of these effects easily by JavaScript combined with DOM, Macromedia's Flash [Macromedia 99] or the working standard SVG - Scalable Vector Graphics [W3C 99c].

We have no better solution for situation 2 and 3 now. But the CORBAConnect can solve these problems.

In situation 2, one can implement a CORBA object to retrieve the information from database, and JavaScript can get the information by retrieving the attribute of remote object. When the information is updated, the server can give you a notification by invoking the operation in the ThinClient interface, which will pass to the event handler OnServerTrigger1 or OnServerTrigger2. We have an example in the next section.

In situation 3, one can setup an information repository that stores the information of each client in the server for all clients to access. When one of the clients update it's information, the client invoke the OnClientTrigger1 or OnClientTrigger2 operation in JS_Object, which will dispatch the event to all of the clients, registered.

3.4 A Simple Stock Quote Example

In this section we will introduce a simple stock quote example to show the power of the CORBAConnect. In this example, we will build a real-time stock quote system. First, we will design the server-side object with following IDL:

```
Interface StockQuote : Interface JS_Object
    // inheriting from the JS_Object to use the capability of two way
communication.
{
        double GetQuote(string Symbol);
        string GetName(string Symbol);
};
```

The implementation of the StockQuote is easy, we only need to lookup the symbol and return the QuoteValue or the company name from the database. And it should trigger the clients by invoke the operation OnServerTrigger1. After the implementation, We can write such a simple JavaScript code to show the real-time stock quote:

```
<HTML>
<HEAD>
<TITLE>Real-Time Stock Quote by CORBAConnect</TITLE>
</HEAD>
<SCRIPT>
/* initialize the ORB and get the StockQuote Object on port 8888 in quoteserver */
orb=new ORB();
StockQuote=orb.get_inet_object("quoteserver","8888","StockQuote");
if(!CORBA_is_nil(StockQuote))
{
  /* if we get the object reference correctly, register the thinclient */
  StockQuote.Register(ThinClient);
}
function update_quote(){
  if(CORBA_is_nill(StockQuote))
  {
    document.forms[0].Company.value="Error on Getting Object Reference";
    document.forms[0].Quote.value="----";
  } else {
    /* update the stock quote */
    document.forms[0].Quote.value=
                  StockQuote.GetQuote(document.forms[0].Symbol.Value);
    /* Unknown Symbol ? */
    if(StockQuote.GetQuote(document.forms[0].Symbol.Value)>=0)
      document.forms[0].Company.value=
                  StockQuote.GetCompany(document.forms[0].Symbol.Value);
    else
      document.forms[0].Company.value="Unknown Symbol !";
  }
};
/* Setup the triggered function */
OnServerTrigger1=update_quote();
</SCRIPT>

<FORM>
Symbol : <INPUT NAME=Symbol LENGTH=10 OnChange='update_quote()' ><BR>
Company : <INPUT NAME=Company size=40> <BR>
Quote : <INPUT NAME=Quote size=8><BR>
</FORM>
</HTML>
```

the screen shot of the result is the [Fig. 2]. To achieve the same result, you may need to write a Java applet with the waste of resource to run the JAVA Virtual Machine. You can also refresh the page every 3 seconds to get the real-time data and your server will have heavy load when more and more users access it. No matter which method you use, the more resource you need.

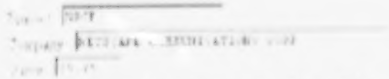

Figure 2: a part of the screen snapshot of the result

4. Conclusion & Future Works

Using the CORBAConnect we can easily access remote CORBA Object via JavaScript with minimum resource. Moreover, more and more enterprises use 3-tier model to access database with CORBA. CORBAConnect can let them to access the data directly only via the browser. The biggest problem of the CORBAConnect is standard. We need to use a special version of browser to provide this feature to user. If it can't be a part of a public browser nobody will use it. Therefore, the future works is completing the whole binding between CORBA and JavaScript and submit a proposal.

5. References

[W3C 99a] The World Wide Web Consortium. (1999) *HTTP - Hypertext Transfer Protocol.* http://www.w3.org/Protocols/.

[Raggett et al. 98] Dave Raggett, Arnaud Le Hors, Ian Jacobs. (1998) *HTML 4.0 Specification.* http://www.w3.org/TR/1998/REC-html40-19980424.

[Arnold 96] Ken Arnold, James Gosling. (1996) *The JAVA Programming Language.* JavaSoft.

[Netscape 98] Netscape Communication. (1998) *Core JavaScript Guide 1.4.* http://developer.netscape.com/docs/manuals/js/core/ jsguide/index.htm.

[W3C 98] The World Wide Web Consortium. (1998) *Document Object Model (DOM) Level 1 Specification.* http://www.w3.org/TR/REC-DOM-Level-1/.

[W3C 99b] The World Wide Web Consortium. (1999) *Web Style Sheets.* http://www.w3.org/Style/.

[Netscape 97] Netscape Communication. (1997) *Dynamic HTML in Netscape Communicator.* http://developer.netscape.com/docs/ manuals/communicator/dynhtml/index.htm.

[Mowbray 97] Thomas J. Mowbray, William A. RUH . (1997) *InsideCORBA - Distributed Object Standards and Applications.* Addison-Wesley.

[Orfali 97a] Robert Orfali, Dan Harkey. (1997) *Client/Server Programming with Java and CORBA.* Wiley Computer Publishing.

[Orfali 95] Robert Orfali, Dan Harkey, Jeri Edwards. (1995) *The Essential Distributed Objects Survival Guide.* Wiley Computer Publishing.

[Orfali 97b] Robert Orfali, Dan Harkey, Jeri Edwards. (1997) *Instant CORBA.* Wiley Computer Publishing.

[OMG 98] OMG Inc. (1998) *Common Object Request Broker Architecture Specification 2.2.*

[ECMA 98] ECMA. (1998) *ECMAScript: A general purpose, cross-platform programming language.* http://www.mozilla.org/js/ E262-pdf.pdf

[OOC 98] Object-Oriented Concepts, Inc. (1998) *ORBacus for C++ and Java Version 3.11.*

[W3C 99c] The World Wide Web Consortium. (1999) *Scalable Vector Graphics (SVG) Specification.* http://www.w3.org/TR/WD-SVG/.

[Macromedia 99] Macromedia Inc. (1999) *FLASH 3 - the web standard for vector graphics and animation.* http://www.macromedia.com/ software/flash/.

From Simple Chat to Virtual Reality: Formative Evaluation of Synchronous Communication Systems for Online Learning

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Abstract: Synchronous conferencing systems are under-utilized in most distance learning environments. Appropriate use of the synchronous CMC systems contributes to student satisfaction and active participation in an online environment. This study employed the formative evaluation method to assess students' perceptions toward different CMC systems. The systems are divided into three categories: text-based chat, audio-video conferencing, and virtual reality applications. The results of the study indicates that, among all synchronous CMC systems employed in this study, text-based and virtual reality conferencing systems are more efficient for synchronous online learning.

1. Introduction

Online learning refers to any type of learning activities that takes place over a computer network. Synchronous online learning refers to online learning that takes place in real time. As an increasing number of courses in various disciplines go online, various types of computer-mediated communication (CMC) systems are also utilized to facilitate online learning. CMC systems, as defined by Kerr and Hiltz, "use computers to structure, store, and process communications" (Kerr & Hiltz, 1982, p. 2). Many research studies have shown that the features of CMC systems can not only reduce physical and social constraints but also increase online interaction and knowledge acquisition (Kay, 1992; Verdejo & Cerri, 1994). Many studies have focused on the final impact of technology on student learning. This research proposes to use formative evaluation to study the process of student learning about new technology. The findings will further the understanding of the applications of the CMC systems for online learning as well as student perceptions toward new technology. As Bloom *et. al.*, (1971) have noted that evaluation is a systematic way of collecting evidence to determine if learning has taken place in individual students. This research used observation, reflection journals, and social presence ratings to survey student perceptions toward CMC systems.

2. Background

2.1. CMC Systems for Synchronous Online Learning
The CMC systems used in the course for this research are a combination of text-based, audio-video, and virtual reality systems. The main communication system is WebCT, which is a web-based learning courseware. WebCT provides a set of tools for instructors and students to engage in online instruction and learning. These tools include: homepage, presentation area, annotation tools, self-testing, course content, course reference material, email, chat room, bulletin board, calendar, searchable image and file archive, syllabus, course content manager, grading tools, timed online quizzes, file manager, indexed searching, student progress tracking, etc. (Goldberg, 1997). In additional to WebCT, the course in this study also utilizes the following systems for synchronous learning:

2.1.1 Text-based Conferencing Systems

2.1.1.1 ICQ. ICQ ("I seek you") is an Internet paging and chat utility. Users can page a partner via the Internet for a live chat. A contact window indicates when another conversation partner has come online. This tool is ideal for small group interaction. Teachers can use it for virtual office hours. (http://www.icq.com)
2.1.1.2 WebCT Chat: a Java-based chat program and a component in WebCT. Group discussions can take place in four separate chat rooms. Conversations in the chat rooms are recorded. (http://www.webct.com)

2.1.2 Audio-video Conferencing Systems

2.1.2.1 Netscape CoolTalk: an audio conferencing system that allows people to talk to each other over the Internet. (http://www.netscape.com)
2.1.2.2. CU-Seeme: a video conferencing system. Users can see and hear each other via a video camera over the Internet. (http://www.cuseeme.com)

2.1.3 Virtual Reality Systems

2.1.3.1 ActiveWorlds: a graphically enhanced 3D-conferencing system. Users are represented by avatars which walk, dance, and jump around in a world. A world is a metaphor for the ideal world that a user would like to build in the cyberspace. Programming knowledge is required to build a world in the ActiveWorlds. Conversations are typed into the chat window and logged automatically. (http://www.activeworlds.com/)

2.1.3.2 The Palace: another graphically enhanced affective conferencing system that also uses avatars to represent conversationalists. The main difference between this system and the ActiveWorlds is that users can change emotional expressions such as sadness, happiness, and excitement on the avatars. Users can dress the avatars using props in the suitcase or from the Internet (http://www.thepalace.com).

The selection of these CMC systems were intended for the students to develop the skills to manage various types of CMC systems. The main criteria of the selections are based on economic considerations. Programs that can be freely downloaded or are easily affordable were first considered. The next section will discuss the online learning activities for synchronous online learning via these CMC systems.

2.2 Synchronous Online Learning Activities

Most of the online learning environments are based on the model of asynchronous learning in which students engage in online activities at a time of their choosing. For courses that emphasize memorization of factual knowledge, asynchronous communication may be sufficient. For a course, such as the one in the present study, that was designed to improve online communication skills, synchronous communication is no less important than asynchronous communication. Students can learn the techniques for online discussions and develop the skills to operate these CMC technologies through synchronous learning. Synchronous communication and asynchronous communication are of equal importance in the curriculum.

There are many options of synchronous activities. For example, one can use guest speakers from remote sites, online debate, and role-play. This course utilizes all these means to enhance student learning interests. To help the students in getting ready for synchronous discussion, two preparations can be done ahead of time: dividing students into small groups and providing guidelines for discussions. Ill-prepared synchronous communication can be characterized as non-linear, chaotic, unfocused, and unproductive. Small group discussions have the advantages of initiating focused, equal, dynamic, interactive, and quality discussions. Sharan and Sharan (1976) postulates that "small groups are an effective organizational medium for encouraging, clarifying, and guiding student participation in planning classroom activities, both academic and social" (p. 10).

Furthermore, all students were given a set of Student-Centered Discussion (SCD) guidelines at the beginning of the semester. The SCD guidelines were adapted from Dr. Linda Shoop's model of SCD (http://home.kiski.net/~dwright/scd/home.html). The SCD guidelines were introduced for the purpose of facilitating discussions and increasing the quality of student participation. The guidelines included two main parts as summarized in the following sections.

2.2.1 The role of the participants

Discussants of online forum should follow the etiquette that ensures good discussions.

1) Respect for each other—be polite to each other.
2) Idea generating—formulate ideas and try to state them in clear terms.
3) Listening—read other peoples' messages before jumping into the debate.
4) Referencing—always include the names of the past speakers when making references to their messages.
5) Display responsible involvement—avoid chitchat in a public forum and try to address the whole group as much as possible.

2.2.2 The role of the moderators

In order to lead a successful discussion, a moderator should make the following preparations to keep the discussion alive:

1) Greeting—Moderators should greet every participant when s/he joins the chat room.
2) Warm—up activities: Moderators can devise short activities to get everyone ready for the formal discussion. For example, the moderator can solicit a quick poll on current issues.
3) Make an opening statement—The statement should provide information for the understanding of the topic of the day before initiating formal debate.
4) Step-by-step discussion process—Ask one question at a time and try to keep the discussion focused.
5) Asking questions—Have several questions ready before the seminar. When the discussants exhaust one topic, the moderator can either build on what has been discussed or ask a new question to keep the discussion going.

6) Scriptwrite the discussion—If necessary, the moderator can write down in advance certain set phrases, e.g., greetings, opening statements, introductions to the guest speaker, etc. It is more efficient to cut and paste these phrases into the chat window rather than keeping everyone waiting until the moderator finishes typing.
7) Concluding remarks—At the final round of the discussion, the moderator should try to consolidate the key points that surfaced during the conference and make concluding remarks.

3. Formative Evaluation

3.1 Methods

Bloom *et. al.*, (1971) defines formative evaluation as "the use of systematic evaluation in the process of curriculum construction, teaching, and learning for the purpose of improving any of these three processes" (p. 117). Bloom *et. al.*, states that "the purpose of formative observation is to determine the degree of mastery of a given learning task and to pinpoint the part of the task not mastered" (p. 61). The results of formative evaluation can help instructors improve curriculum design for better learning outcomes. Furthermore, formative evaluation can contribute to the improvement of computer-based educational technology (Flagg, 1990) The results of the formative evaluation in this study can help educators make useful decisions in selecting CMC systems.

The methods used in this study includes reflection journals, observations, and social presence ratings. Students were asked to reflect on the use of each CMC system in their weekly journals. The researcher also took notes while observing student adaptation to a new CMC system. After each use of the CMC system, students were also asked to complete a social presence ratings survey. Social presence is the degree to which senders and receivers can sense each other during their communication (Short *et. al.*, 1976). People interact differently according to the degree of social presence they feel. High social presence can convey multiple, nonverbal communication channels and continuous feedback. The social presence ratings used in this research employed semantical differential techniques that included a number of bipolar questions. For example, students were asked to rate a CMC system on a one-to-seven scale based on the following bipolar pairs: Impersonal - Personal; Distant - Close; Dehumanizing - Humanizing; Expressive - Inexpressive; Emotional - Unemotional; Insensitive - Sensitive. The results will be discussed in section 4.

3.2 Research questions

In order to gain a better understanding of student adaptation to technology, I posed the following questions:
1) What are the advantages and disadvantages of the CMC systems for synchronous learning?
2) How do students adapt to each CMC system?
3) How efficient are these CMC systems for communication?

3.3. Settings and Procedures

The data for this research is based on a writing-intensive online course, "COM459: Theories and Applications for Computer-Mediated Communication Systems", that took place in Fall 1998 in the Department of Communication at the University of Hawaii. The CMC systems employed in this course included the following three categories: text-based systems, audio-video conferencing, and virtual reality systems. The main objective of this course was to better the understanding of CMC systems through efficient use of various CMC systems. The student population consisted of junior, senior, and graduate students in communication, business, journalism, ESL, and philosophy. The majority of students are majoring in Communication.

This course was conducted through both synchronous and asynchronous CMC systems. This research focused only on the synchronous components. The students joined an online seminar once a week via various CMC systems. Each group took turns moderating the discussions. The host group needed to choose a topic related to CMC theories and post questions for discussion in advance. On the day of the seminar, the host group would moderate and facilitate the discussions.

4. Discussion

The following discussion addresses the three research questions. The first research question is answered through the researcher's observations. The second question is based on the analysis of students' reflection journals. The findings to the third question are based on the results of the social presence ratings.

4.1 Pros and Cons of CMC systems

Based on the researcher's observations and student experience in using various CMC systems, the pros and cons of each system are summarized as follows (Table 1):

Table 1

CMC Systems	Pros	Cons
WebCT	a. All conversations are recorded b. General and private conferencing rooms for small groups c. A sense of place, i.e., virtual office, student lounge d. Private chat with individuals during a public session	a. Mac users typing interrupted b. Technical glitches—Unexpected server shutdown c. Browser incompatibility (works best in Netscape 4)
ICQ	a. Contact list—auto-detect if a friend is online b. Instant messaging—low bandwidth, point-to-point c. Status indication—showing if one is occupied, away, or available for chat d. Student help line—easier to reach the instructor e. IP lookup for modem users on dynamic IP addressing	a. Interruption of work b. One-to-one conversation only
CU-Seeme	a. Real interaction—sound and sight b. Conversation of international guest speakers c. Low cost & high quality interaction	a. Time-consuming preparations—required frequent testing of connections b. Time zone differences—difficulty in scheduling with users in different time zones c. Transmission difficulty caused by network congestion d. High bandwidth
CoolTalk	a. Efficient voice conversation over the Internet b. Free and easy to setup c. Saves phone bills	Bandwidth & network congestion
ActiveWorlds	a. Personalized avatars b. Constructing your own world c. Exploring 3D virtual campus d. Indicating movements: dancing, waving, jumping, and greeting	a. Initial Disorientation b. Programmer required
The Palace	a. Mood indicator—happy, sad, angry, exciting, thinking, etc. b. Wearable avatars—dress the avatars in any customs c. Text-to-speech—for the visually challenged d. Graphic-enriched backgrounds e. Increased interactions and active involvement	Navigation & room capacity (8 people/server)

4.2 Student Perceptions

Student comments reflect the process of adapting to a new technology and what they like or dislike about these systems. The following sections are synopses from the student reflection journals.

4.2.1 WebCT

"One thing that bothered me is the lack of organization. With everyone talking at one time it is difficult to actually 'hear' anything that is being said."

"I still find chat rooms to be a very artificial means of communication...seemed to have more of a time lag than the other two computers...by the time I posted another question, her reply would pop up."

"When I was in chat and trying to type a message, every time someone else submitted a line my cursor jumped away from where I was typing."

4.2.2 ICQ

"ICQ has a chat function exactly similar to CMC cafe. Real time chatting is easy to follow and you don't have to wait for the other party to respond."

"Using chat for that projects was effective and interesting"
"I started using icq. It's a bit strange at first, but when you get started, it's fun."
"The way you can see the other person typing in everything is so immediate, I thought this was very exciting. You can leave notes if the other person isn't online."

4.2.3 CoolTalk

"The delay was a little frustrating at first, but once we got the hang of it we could work the worksheet well. Nothing is ever fast enough with technology, I guess I expected the communication to have clear, immediate results. I've never communicated through audio or visual so it was a great experience to see and hear the conversation with (guest speaker)."
"CoolTalk activity was fun and also enlightening- I especially like the hands-on experiential qualities of the small group face-to face and through CoolTalk interaction. Due to poor sound (I believe the speaker in the computer I was using is cracked), CoolTalk transmission was not as successful as it could have been, "

4.2.4 CU-Seeme

"At times the audio wasn't all that great on some of the systems but I enjoyed using the system."
"Unless your connection is fast, then the picture quality is very poor. Video allows people to see one another halfway across the world."
"I wasn't very impressed with the synchronous communication systems (CoolTalk and CUSeeMe) we saw last week. The video images were really poor and the quality of the communication was also. I don't think that the current technology is very useful. When improvements in reception are made, then I think people will be inclined to use it."

4.2.5 ActiveWorlds

"The virtual world was an interesting experience. Instead of chatting with another person in text on a screen, you can choose avatars that resemble yourself giving you a feeling of more interactions. The surroundings in the virtual world are also creative and eye catching. The movement is rather slow, but the chats are immediately posted."
"The Virtual University also wasn't impressive. It just seemed like a glorified computer game which just replaced the traditional lecture style classroom with a virtual environment,"

4.2.6 The Palace

"It creates interest in wanting to be there, which is then conducive to learning."
"It has real potential to be used in education. It seemed to me to be the best system out of all the ones we have tried."
"The ability to wear an avatar can give an added sense of personality"
"We were having some difficulties because not everyone showed up and one of the other students had trouble with lag time. But acting out the legend was pretty fun and it was good to have the audio and visual to work with."

4.3 Social Presence Ratings

Students completed the social presence ratings immediately following each use of the system. Some systems were used only once through the entire semester. Some systems were used repeatedly, e.g. WebCT. Pre-test and post-test were conducted for systems used more than once. The results of the ratings are indicated by the mean scores of each system on a one-to-seven scale. The higher the score, the higher social presence ratings each system receives.

WebCT Post-test:	5.3
The Palace post-test:	5.1
The Palace pre-test:	4.2
WebCT pre-test:	4.1
ActiveWorlds:	3.9
CU-Seeme:	3.8
CoolTalk:	3.4

The ratings for the audio-video conferencing systems such as CU-Seeme and CoolTalk are much lower than the text-based and virtual reality conferencing systems. This is partially due to the poor audio and video quality during the seminars. The video and sound quality was constraint by the available bandwidth during the seminars. The time lags during conversations made the communication laborious. Students had to repeat questions several times to get the messages across the wire. Although, in the reflection journals, students seemed to be excited about the possibilities of audio-video conferencing, the results of the social presence ratings indicated that they are not convinced that audio-video conferencing systems were ideal for effective communication at the time that the conference took place.

Interestingly, students complained excessively about WebCT in their journals at the first week of practice. WebCT received the highest social presence ratings at the end of semester survey. This may explain that time is a critical factor in adapting a new system. The more often the students practice on one system, the more comfortable they are with the system. Furthermore, the ease of use of the text-based conferencing (WebCT) made the conversation much smoother and less distracting in online conferencing. The virtual reality system (The Palace) came in second place. This is an indication that the add-on affective components made the conversation more realistic. Students liked to apply emotional expressions to their avatars to facilitate the communication.

5. Conclusions

The appropriate use of CMC systems can contribute to synchronous online learning in the following ways:

1) Enhanced cognitive and affective learning outcomes: students come to a new understanding of a course-related subject through in-depth online discussion. They are more motivated to keep up with the learning while interacting with each other in real-time.

2) Increased interpersonal connections: students generally appreciate the instant feedback from the instructor and fellow students during synchronous communication. They also get to know each other better through online social interaction.

3) Active learning: when students were bestowed with the responsibility to plan and lead a seminar, they became active learners in the process of planning and moderating a seminar.

4) Equal participation: shy students tend to speak up more in online seminars than in face-to-face meetings.

To ensure a successful synchronous seminar, in addition to the activity design, the selection of the CMC systems is critical in the planning process. It can be time-consuming in planning an online seminar and technology failure is sometimes unavoidable. Nevertheless, within the controllable variables, I recommend the following criteria for selecting a CMC system: ease-of-use interface, cross-platform, conversation logs, indication of the presence of the attendees, function to create new chat rooms, add-on affective components (e.g., emotional expressions), and strong technical support from the system developer.

In short, the keys to successful synchronous online learning rely on the appropriate activity design (e.g., student-centered discussion) and a good selection of the CMC systems. This study focuses on the evaluation of the CMC systems. Future research should also focus on the effects of the various types of online activities for synchronous learning.

6. Bibliography

Bloom, B. S., Hastings, J. T., & Madaus, G. F. (1971). *Handbook on formative and summative evaluation of student learning*. New York, NY: McGraw-Hill Book Company.

Flagg, B. N. (1990). *Formative evaluation for educational technologies*. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Goldberg, M. W. (1997). Using a Web-based course authoring tool to develop sophisticated web-based courses. In B. H. Khan (Ed.), *Web-based instruction* (pp. 307-312). Englewood Cliffs, NJ: Educational Technology Publications.

Kay, A. R. (1992). *Collaborative learning through computer conferencing: The Najaden paper*. Berlin: Springer-Verlag.

Khan, B. H. (1997). *Web-based instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Kerr, E. B., & Hiltz, S. R. (1982). *Computer-mediated communication systems: Status and evaluation*. New York, NY: Academic Press.

Sharan, S., & Sharan, Y. (1976). *Small-group teaching*. Englewood Cliffs, NJ: Educational Technology Publications.

Shoop, L (1998). *Student-Center Discussion*. http://home.kiski.net/~dwight/scd/home.html.

Verdejo, M. F., & Cerri, S. A. (Eds.). (1994). *Collaborative dialogue technologies in distance learning*. (Vol. 133). Berlin: Springer-Verlag.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. New York, NY: John Wiley.

An Evaluation Framework for Web-Based Document Directory Systems

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Abstract: In general, a Web-based Document Directory System (DDS) may be considered as a modular system that enables users to efficiently locate desired documents dispersed or accessed over the network. In this paper, we have focussed on full-text direct querying (search systems) and catalog traversal (catalog systems) and we propose and demonstrate a framework for evaluating such systems, in relation to application requirements. This framework consists of two sets of evaluation criteria classified under specific areas of functionality and an evaluation methodology that demonstrates how the criteria can be used to facilitate the process of selecting the appropriate DDS components. Finally, we provide two case studies for two real life projects in which we have applied it.

1. Introduction

The problem we attempt to address is to introduce an evaluation framework to help DDS developers to choose the appropriate systems/tools that can compose an effective DDS for a distributed document-base according to specific requirements. These requirements are derived from the needs of the main users involved in the life cycle of a DDS, namely end-users and DDS developers (information providers, administrators and programmers). Such requirements include the type of information one intends to organize, the format it is stored in, multilingual support, etc. The following factors accentuate the problem: (a) the large number of such requirements, (b) the large number of available systems with various characteristics and features, (c) the constant and fast evolution of systems' features, (d) the high degree of diversity of content that a DDS should support and (e) the lack of an evaluation framework to easily and accurately select the best system for specific requirements.

We have focussed on the following two, widely accepted strategies for locating documents: Full-text direct querying (search systems) and catalog traversal (catalog systems). These classes of systems/tools complement the functional definition of a DDS in an architectural context, when integrated as components into a DDS. A *catalog system* (alias subject catalog/tree/index/hierarchy) is a tool that provides a structured and organized hierarchy of categories for browsing information by subject. Documents are assigned to (placed in) categories either by their authors or by the subject-tree administrators. Catalog creation and maintenance may be done manually or with the help of tools that accommodate dynamic creation of subject-trees, based on characteristics of the documents that are being organized (namely filename, URL, meta-data etc.). In the case of *search systems*, the transformation on the document base is done through a process of document gathering, parsing (e.g. extraction, summarizing) and indexing. By ranking the extracted information (for instance in the case of text, by its position in the title or text, the number of times it appears in the document, etc.), the database reduces the number of incidental hits, known as false drops, from those relevant to the topic.

Related work on evaluation of search or catalog systems is focused on evaluation of Web Search engines (like Altavista, Lycos, etc.) or Web Directories (like Yahoo) from the end-user's point of view, who searches the entire Web. Thus, such evaluations test the systems on their search capabilities such as Boolean logic, truncation, field searching, etc. and evaluate the performance of the systems with respect to precision and response time. Moreover, most of these are Internet services rather than tools that can be purchased and installed for local use. There exist a large number of such comparing studies, either produced by researchers (like [Barry 96],[Winship 95], [Westera 95]) or by well-known companies specialized in evaluating online products and services like, CNet, PCMagazine, PCComputing, Internet World, etc. (see http://www.searchenginewatch.com/). Since the services are constantly changing, these compilations or recommendations are of short validity. Most of them are presenting charts with rated checklists of features and attributes. On the other hand, evaluations focused on the developer's requirements, are very few, like an article of ZDNet that compares six server-based packages (http://www.zdnet.com/products/content/zdim/0303/278624.html), but the criteria are very generic and abstract.

Establishment of the framework implies definition and classification of evaluation criteria and introduction of an evaluation methodology, which are presented in [Evaluation Framework]. Evaluation criteria stem from user requirements, some of which are elaborated in [User Requirements]. More detail description of the application of the framework in the two case studies is provided in an extended version of this paper [Christodoulou et al. 98b].

2. User Requirements

The selection of evaluation criteria is based on a broad set of requirements from both end-users and people responsible for deploying a DDS (information providers and administrators, programmers). Most of these requirements have been gathered through real-life projects (ISTOPOLIS [Papaterpos et al. 98] and VHF [VHF]) and web site development efforts we have participated - Hellenic Ministry of Culture (www.culture.gr), Hellenic General Secretariat of Sports (www.sportsnet.gr), Hellenic Ministry for the Environment (www.minenv.gr). Moreover, some of them represent features that are offered by powerful tools or attempt to address emerging functionality of retrieval systems. Some of the most important requirements are discussed in this section.

A basic characteristic of many real life systems is the *wide variety of document formats* that should be all supported by a single DDS. Another important user demand is the support of documents in *multiple languages*. Multilingual support may range from support of multiple collating sequences to full implementation of complex linguistic query processing methods such as phrase recognition, thesaurus and stemming.

Disperse of documents over various sites over the network poses the issue of *distribution of the services and sub-components* of the DDS. Possible scenarios include distributed, centralized or multi-tier configurations and affect the response time, performance and bandwidth utilization of the system. Choice of architecture also affects issues such as data delivery between distributed components and caching. Sometimes, especially in the case of distributed systems, there is the need to exploit an existing DDS component (for instance during a migration period from one system to another) or integrating components from different vendors. The question of supporting *open standards* is vital for achieving interoperability among different systems or platforms. Some of the most popular standards include HTTP, Z39.50, SOIF, RDM, Robot Exclusion Protocol. Another important aspect of an effective DDS concerns its *user interface* (getting user input and presenting results). Requirements on the user interface may include customizability of the interface, format of results returned, etc.

Another requirement significant for both end-users and administrators is the DDS *performance*. A DDS component should provide results of high precision and recall at small response times. *Security* is another broad subject of increased importance in many cases. As far as the DDS is concerned, there are several levels of security requirements, ranging from the ability to access secure documents over secure connections (e.g. in the gathering process) to applying access control lists on the indexes or catalog structures and allowing specific users to search specific parts of the document space. In addition to speed and security in accessing information, *integrity of the information* should be enforced. Data integrity is violated when the DDS returns links to documents that have been removed form the document base. The effectiveness of the search component of a DDS relies heavily upon the ability of the system to support advanced *query techniques*. Such techniques include use of thesauruses and dictionaries, term truncation, stemming and inflection, query approximation.

As far as *indexing* is concerned the efficient and flexible summarizing of documents and incremental indexing constitute important issues. The DDS should utilize *meta-information* contained in the documents (in the form of meta data or document properties) that could assist in more detailed fielded searching and auto cataloging. In special cases, where a large volume of data is organized into a relational database that coexists with documents that reside outside the database, there is a need for a common unified retrieval mechanism that enables the user to retrieve information stored in the database or in the documents with a single query. This scenario is further complicated by the introduction of mixed mode documents that may contain real time data from database tables. This need is commonly addressed at the database level, however, there exist document search systems that offer *interoperability with RDBMS*.

An out-of-the-box tool may not meet all user requirements. Such a tool should therefore be *configurable and customizable*, by providing APIs and toolkits to administrators and developers, in order to extend or customize the capabilities or the interface of the system. Moreover, in order for a DDS to be fine-tuned, it should enable the people that deploy to effectively administrate its components. *Efficient administration* can be in turn translated into a series of features such as easy, secure, remote administration, offering fine-grained control of DDS functions, logging and scheduling of administrative operations.

3. Evaluation Framework

In defining this framework, we have drawn from our experience presented in [Christodoulou et al. 98a], where we introduced an evaluation framework for Hypermedia Application Development and Management Systems. The process of evaluation consists of two steps: (1) *definition and grouping of evaluation criteria* and (2) *definition of an evaluation methodology*.

3.1 Definition and Grouping of Evaluation Criteria

Based on the requirements discussed in the previous section, we propose two sets of evaluation criteria for search and catalog systems respectively. These criteria are grouped into several *basic categories*, which allow the user of the framework to focus on specific areas of functionality of the systems, like searching capabilities, administration topics, etc. Additionally, *cross categories* are introduced, to group criteria of various basic categories, under different contexts. Such categories include multilingual support, security features, etc. The two sets of evaluation criteria, grouped by basic category, are outlined in [Fig 1]. [Fig 2] graphically represents how they are grouped under the basic and cross categories, for both Search and Catalog Systems.

3.2 Definition of an Evaluation Methodology

In this section, we introduce a simple methodology (using a grading algorithm) for a comparative evaluation of DDS components, with respect to specific requirements, based on the above-mentioned criteria. The proposed evaluation methodology consists of four steps that are described in detail below. The same methodology can be used for either search or catalog systems and for each basic or cross category separately.

Step1: Selection and evaluation of candidate systems. For each criterion and for each system under evaluation, a number is defined that indicates the extent to which the criterion is covered by the system. We represent this number as $CD_{\#crit}(system)$, where CD stands for *Coverage Degree*, *#crit* = the criterion label (e.g. D2) and *system* is one of the Search or Catalog Systems under evaluation. We assume $CD_{\#crit}(system)$ to be an integer in the range of 0 to $max_{\#crit}$ -1, where $max_{\#crit}$ is the number of all the possible values for the $CD_{\#crit}(system)$. The value of $max_{\#crit}$ depends on the criterion *#crit* and could be 2 (the criterion is either supported or not) or greater. The coverage degree of most of the criteria becomes more difficult to estimate as $max_{\#crit}$ increases, while assigning very high values to $max_{\#crit}$ does not seem to have a meaningful effect on results. On the other hand, low values of $max_{\#crit}$ may lead into inadequate representation of differences between two systems on certain criteria. For criteria that accept continuous values, ranges of such values may be defined (according to system features and user requirements). If a user simply requires that the value for the criterion falls into a specific range (and not that the value is smaller or larger than a threshold), then grading is done in the same way as in the previous case. Otherwise, the number of these ranges in a criterion determines the $max_{\#crit}$ for this criterion. If smaller values of the criterion indicate better behavior (e.g. price or size of index), then before calculating $CD_{\#crit}$, the ranges defined are sorted in descending order. Otherwise, (e. g. transactions per second, max number of concurrent users) ranges are sorted in ascending order. In this step, the user of the framework: (a) selects a set of candidate systems, and (b) estimates $CD_{\#crit}(system)$ for all the evaluation criteria.

Step2: Specification of requirements. Based on the requirements of a certain DDS, the user selects the criteria on which he/she wishes to base the evaluation and specify the minimum extent to which each such criterion should be supported. This is represented as $RCD_{\#crit}$, where RCD stands for *Required Coverage Degree*. $RCD_{\#crit}$ is an integer in the range 0 to $max_{\#crit}$-1. Criteria not selected for evaluation are assigned an $RCD_{\#crit} = 0$.

Step3: Ranking systems. In this step, the candidate systems are graded according to the $RCD_{\#crit}$ values specified by the user during *Step2*. For each of the candidate systems, a number *NRANK(system)* is calculated, which is the *Negative Rank* of the system. It's a number between -1 and 0, and indicates the ability of the system to efficiently cover the specified requirements. The larger this number is, the more effectively the system succeeds in covering user requirements. For the calculation of this number, the following simple algorithm is used:

```
$NRANK = 0; N = 0$
for each $\#crit$ do
  if $RCD_{\#crit} > 0$ then
    $N = N + 1$
    if $RCD_{\#crit} > CD_{\#crit}(system)$ then $NRANK = NRANK - ( RCD_{\#crit} - CD_{\#crit}(system) ) / ( max_{\#crit} - 1 )$
  end-if
end-for
$NRANK(system) = NRANK / N$
```

Using the same algorithm on the corresponding criteria of each basic or cross category (*categ*), the number $NRANK_{categ}(system)$ is calculated to indicate the extent to which a system reaches or supercedes the specified requirements in the specific category. Thus, the framework enables evaluation of the candidate systems on specific areas of functionality as these are defined by the various categories, and gives results in various levels of detail.

Step 4: Decision procedure. To reach a final decision the user is presented with a list of the systems sorted by *NRANK(system)*. For each of the systems under evaluation, starting from the one with the largest *NRANK*, the framework provides a list of all the specified requirements that are not sufficiently covered. The user checks

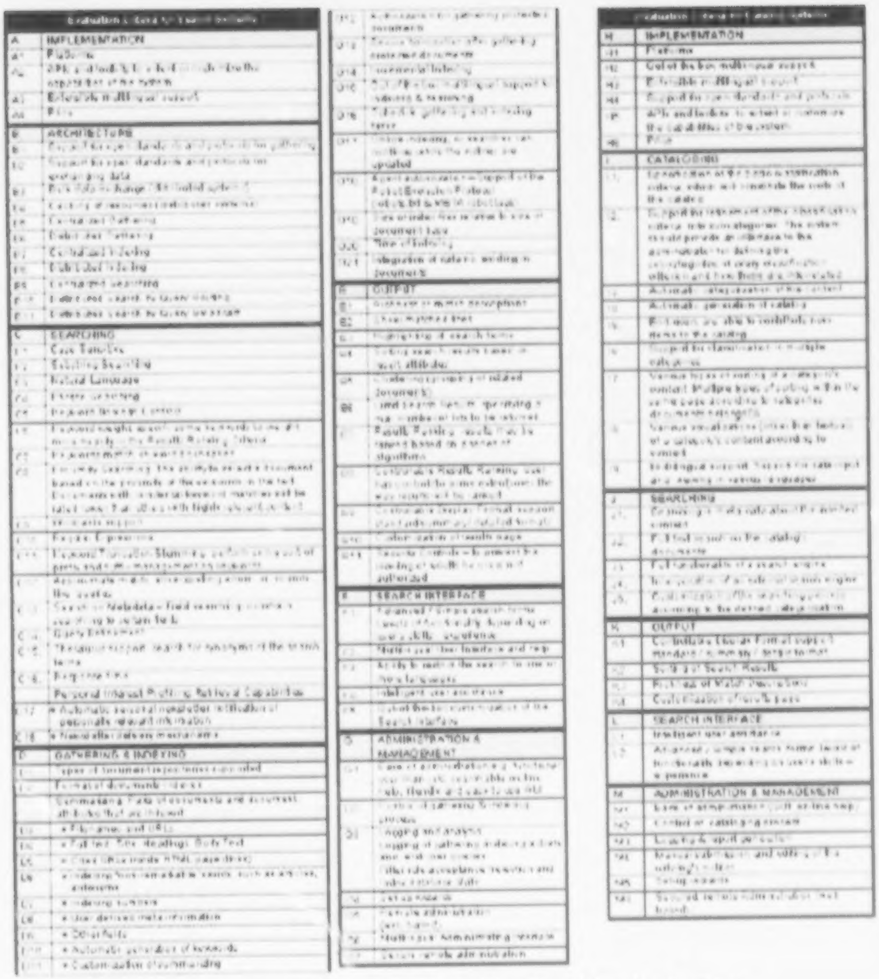

Figure 1: The evaluation criteria for Search and Catalog Systems

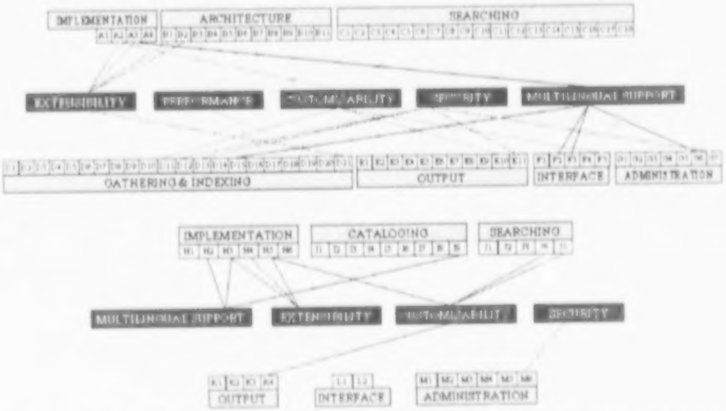
IMPLEMENTATION
ARCHITECTURE
SEARCHING
A1 A2 A3 A4
EXTENSIBILITY
PERFORMANCE
CUSTOMIZABILITY
SECURITY
MULTILINGUAL SUPPORT
GATHERING & INDEXING
OUTPUT
INTERFACE
ADMINISTRATION
IMPLEMENTATION
CATALOGING
SEARCHING
H1 H2 H3 H4 H5 H6
MULTILINGUAL SUPPORT
EXTENSIBILITY
CUSTOMIZABILITY
SECURITY
K1 K2 K3 K4
OUTPUT
L1 L2
INTERFACE
M1 M2 M3 M4 M5 M6
ADMINISTRATION

Figure 2: Classification of evaluation criteria for Search and Catalog Systems into Basic and Cross categories

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whether these weak points of the selected system are acceptable and proceeds to the acceptance or the rejection of the system. If none of the candidate systems meets the specified user needs to a satisfying degree, the user may return to *Step2* and specify lower *RCDs*, or search for other systems to evaluate through the framework.

4. Case Studies

The framework described in this paper was used in order to select appropriate DDS components in two real-life hypermedia applications, VHF and ISTOPOLIS.

The *Virtual Hypermedia Factory environment (VHF)* [VHF] is a distributed, web-based hypermedia environment providing content and services in the sectors of culture, tourism and publishing. The VHF Project aim to provide a platform, based on Internet technologies, composed of integrated solutions, services and tools. Within this project, the authors of this paper were responsible for the deployment of the VHF DDS. To this end, we introduced the framework under discussion and applied it for the selection of the DDS components twice, at different stages of the project and on different sets of evaluated systems. Based on the user needs collected from users that participated in the project, we focused on the following fundamental requirements: *distribution of resources, multilingual support* and *flexible / customizable user interface*.

ISTOPOLIS is a network-based hypermedia educational system for history and culture, offering a broad set of services on media rich environment to teachers, students and content providers. The system can operate over the classroom LAN, over a remote connection to a server or as a stand-alone application. Design of ISTOPOLIS is based on a concrete set of pedagogical and educational goals and requirements [Papaterpos et al. 98]. In the case of ISTOPOLIS, *support for the Greek language, support for IIS under Windows NT,* and *customizable cataloging* were among the strongest requirements.

4.1 Application of the Framework

In both cases five search systems: Harvest v5.1 (harvest.transarc.com) [Bowman et al. 94] incorporating Glimpse Search Engine (glimpse.cs.arizona.edu), Netscape Compass Server v3.01 (home.netscape.com), Verity Information Server v3.6 (www.verity.com), AltaVista Search Intranet v2.3 (www.altavista.com), Microsoft Index Server (www.microsoft.com) and two catalog systems: Netscape Compass Server v3.01 and University of Patras Interactive Thematic Catalog System [Styliaras et al. 98] were selected for evaluation.

As mentioned in [Definition of an Evaluation Methodology], large values of $max_{sc,ri}$ increase the difficulty to accurately estimate $CD_{sc,ri}$ and $RCD_{sc,ri}$ values. In order to simplify the methodology, without seriously affecting final decisions, we assume that $max_{sc,ri}$ equals 4 for all criteria, apart from those accepting binary values (the criterion is either supported/covered or not). For the former, $CD_{sc,ri}(system)$ and $RCD_{sc,ri}(system)$ are integers in range of 0 to 3, with four discrete values: 0 = not supported, 1 = poor support, 2 = acceptable support and 3 = full support. For criteria accepting binary values, $max_{sc,ri}$ equals 2. Naturally, one could make different assumptions concerning the values of $max_{sc,ri}$ for each criterion separately. Based on the above assumptions we applied the methodology, in both case studies, in the manner described below:

Step1: We estimated $CD_{sc,ri}(system)$ for all the evaluation criteria and for all the candidate systems.

Step2: According to the requirements of each application, we specified the $RCD_{sc,ri}$ values.

Step3: For each system under evaluation, *NRANK* was calculated. The values are presented in [Fig 3(a-d)]. Furthermore, *NRANK* was also calculated for the most important criteria categories, namely "search system: architecture" for VHF and "catalog system: cataloging" for ISTOPOLIS. See [Fig 3(e-f)].

Step 4: In the case of VHF Search System, we first considered the systems with the highest *NRANK*, namely Compass Server, AltaVista and InfoServer. Since *NRANK* values for these systems are very close (-0.26, -0.27 and -0.28 respectively), we further examined how well they cover the critical requirements of VHF DDS. This process revealed that Compass Server outperforms Altavista and InfoServer, especially as far as architecture criteria are concerned ([Fig 3e]). Since VHF requirements for the architecture were quite strict and could not be modified, we selected Compass Server as the search component. For the selection of the VHF Catalog System, NRANK values for the evaluated systems were quite close (Compass: -025 and ITC: -022). Thus we had to further examine how the systems cover the most important requirements, which were the multilingual support and flexible cataloging. This procedure indicated that ITC is better for implementing the VHF Catalog System.

The framework was applied in more or less the same way for ISTOPOLIS. Even though Index Server was ranked third, the requirement for specific platform (Windows NT and IIS web server) and programmatic customizability (through API) led to its selection as the Search System of ISTOPOLIS (Index Server is customized through code in the setup process of ISTOPOLIS on the classroom LAN). Selecting the Catalog System for ISTOPOLIS was rather straightforward, as you see in [Fig 3(d)] and [Fig 3(f)].

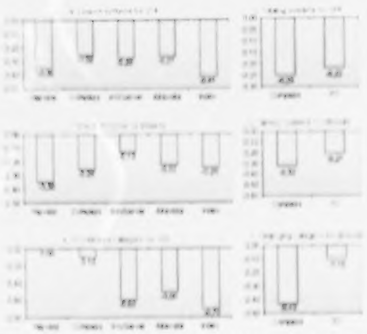

Figure 3: Evaluation of Systems for the VHF and ISTOPOLIS case studies

5. Conclusions

In this paper we propose and demonstrate an approach for evaluating Search and Catalog systems as components of a Web based DDS, in relation to application requirements. The most important part of the proposed framework is the identification of the evaluation criteria and their classification / grouping under specific areas of functionality. This helps people responsible for deploying a DDS to formally and systematically formulate their requirements for a specific application. Furthermore, an evaluation methodology is proposed to demonstrate how the criteria can be used for evaluating systems, in order to select the DDS components that are most appropriate for the given requirements. Application of the framework on a variety of cases may suggest important enhancements or modifications for a specific Search or Catalog system. Two such cases involving applications of different functionality and basic requirements have been presented.

Apart from customization capabilities already described (e.g. introduction of ranges for criteria that accept continuous values), the framework may be extended in various ways. For instance, additional criteria may be defined and weighting techniques or other grading algorithms may be applied. Finally, in order to increase its usability, it is in our intention to create a web-based environment that will functionally implement this evaluation framework. In such a case the administrators of the environment will be in charge of estimating and inserting the features of new systems or update them if new versions appear on the market. Thus, the users will not have to be always informed on new products or read all the technical details about their features. By using this environment and specifying their requirements, the framework will assess the products for them, indicating their weak sides.

8. References

[Barry 96] Barry, T. & Richardson, J. (Nov 1996) *Indexing the Net: a review of indexing tools*. AUSWeb96: Landscaping the Web, Gold Coast, Queensland, Australia, 7th-9th July 1996.

[Bowman et. al. 94] Bowman, C.M., Danzig, P.B., Hardy, D.R., Manber, U. & Schwartz, M.F. (1994). *The Harvest information discovery and access system*, in: Proc. of the 2nd World Wide Web Conference, Chicago, Illinois, October 1994.

[Christodoulou et. al. 98a] Christodoulou, S. P., Styliaras, G. D. & Papatheodorou, T. S. (1998). *Evaluation of Hypermedia Application Development and Management Systems*, Proc. ACM Hypertext '98 p1-10, Pittsburgh, PA, USA, June 20-24.

[Christodoulou et. al. 98b] Christodoulou, S. P., Papaterpos, C. M., Styliaras, G. D. & Papatheodorou, T. S. (1998)., *An Evaluation Framework for Web-Based Document Directory Systems*, Technical Report HPCLAB-TR-021298.

[Papaterpos et. al. 99] Papaterpos, C. M., Styliaras, G. D., Tsolis, G. K. & Papatheodorou, T. S. (1999). *Architecture and implementation of a network based educational hypermedia system*. IEEE ICMCS '99, June 7-14.

[Styliaras et. al. 98] Styliaras, G. D., Zafiris, P. A. & Papatheodorou, T. S. *Implementing highly configurable Subject Trees: The ITC system*. WebNet' 98, November 7-12, 1998.

[VHF] Program ESPRIT No 22251 - "*VHF: An environment for a Virtual Hypermedia Factory*", http://www.vhfnet.com/

[Westera 95] Westera, G. (1995). *Searching the Web for information: how do we fare?* AUUG & Asia-Pacific World Wide Web Conference, Dalring Harbour, Sydney, NSW, Australia, October 1995.

[Winship 95] Winship, I. (1995). *World Wide Web Searching Tools - An Evaluation*. VINE, (99), 49-54.

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Design of support tools and knowledge building in a virtual university course: Effect of reflection and self-explanation prompts

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Abstract: In a WWW-based virtual learning environment where students and teacher are physically separated, the quantity and quality of interaction among students or with instructors have effects on learning. Lack of constructive activity is often identified as one of the major causes for poor learning. We developed support tools (prompts which support students to use self-explanation and self-monitoring strategies) and studied how support tools facilitate convergent knowledge building processes in a WWW-based virtual university engineering course.

For the study, a quasi-experimental study was designed. An engineering class of a virtual university was selected as the research site and the students in the class were randomly assigned to 2 different work environments: 1) without support tools, and 2) with support tools.

This study has an implication for theory that the opportunity to engage in interaction itself is not enough for students to integrate knowledge or develop/ improve the coordination of group work in an online learning environment. Students' frequent interaction with their peers is not enough either for students to integrate knowledge or develop/ improve coordination of group work in an online learning environment. The type of interaction matters, especially because convergent type of interaction facilitates students' knowledge integration.

1. Introduction

In a WWW-based virtual learning environment where students and teacher are physically separated, the frequency of online interactions among students or with instructors may have an effect on learning. One positive effect is that these interactions may facilitate knowledge building activities in virtual courses. However, negative effects, like lack of interactions, may surface. The lack of such an interaction may be one of the major causes of unsatisfactory learning experiences. However, problems may arise even when interactions between students in distance learning occur. The types and the quality of interactions matter. Many students in a virtual university simply tend to post their ideas or read others' ideas without engaging in deep thinking processes such as analyzing, evaluating, and synthesizing ideas. Furthermore, students often merely browse the WWW superficially and do not engage in thoughtful and active learning (Ritchie & Hoffman, 1997). If students rarely engage in convergent knowledge building in a virtual university environment, the knowledge building process is not complete, and students are not able to construct new understanding or build new concepts.

This lack of knowledge linking and structuring activities in the online learning environment was identified as a problem in the networked learning environment by previous studies (Chung, 1999; Harasim, 1990; Harasim, Calvert, & Groeneboer, 1997; Hewitt, 1997) and can have a negative effect on both the students' efforts to synthesize ideas and group collaborative processes (Hewitt, 1997). This study proposed to develop support tools to foster learning in such an environment and investigated the characteristics of interactions with the aid of the support tools in a WWW-based virtual learning environment.

The purpose of this research was to study how support tools facilitate knowledge building processes in a WWW-based virtual university engineering course. Specifically, the first objective was to examine whether students engage in different types of knowledge building activities in when they use support tools. The second objective was to assess the effect of support tool use on student performance.

The research result indicates that students did not engage in different types of knowledge building activities when they used support tools. However, the research findings confirmed that the use of support tools enhanced student performance in integrating concepts in group report writing. This study has an implication for theory that the opportunity to engage in interaction itself is not enough for students to integrate knowledge or develop/ improve the coordination of group work in an online learning environment. This study's implication for the design of a virtual learning environment is that support tools be designed to promote student convergent knowledge building and higher knowledge integration.

2. Knowledge building Processes

This research views learning as a knowledge building process through the mediation of social interaction, tool use, and reflection. Knowledge building is similar to knowledge integration (Linn & Elyon, 1996 cited by Davis, 1998) which refers to the process of expanding a repertoire of ideas, discriminating between ideas, and reorganizing the links among them. Exploration and construction represent divergent and convergent aspects, respectively, of knowledge building. On one hand, divergent knowledge building entails exploring and sharing of diverse ideas which can lead to convergent knowledge building. On the other hand, convergent knowledge building involves linking ideas (Harasim, 1990), constructing explanations (Chan, Burtis, & Bereiter, 1997), making connections among different ideas, and bringing ideas together (Hewitt, 1997). In classroom or group discussion situations, students' exposure to many different ideas does not automatically lead them to new levels of understanding, construction of new concepts, or problem solving. Students learn new concepts or reach new understanding only if they engage in both divergent and convergent knowledge building activities. These knowledge building activities are facilitated by using self-explanation and self-monitoring strategies (Palincsar & Brown, 1984).

Learning process is dynamic, recursive, and iterative (Chung, 1996). Students constantly define problems or the purposes of their learning, explore different information and ideas, evaluate their relevance, and accept or reject ideas to be used for one's purpose. During this dynamic process of learning, students' capabilities to plan and monitor their whole learning processes are crucial. A learner's mental activity to plan and control one's learning processes is called reflection, which is a trait of experts (Ertmer & Newby , 1996). Students who received explicit instruction about planning/monitoring and self-explanation strategies (Bielaczyc, Pirolli, & Brown, 1995) develop a higher understanding than those who received implicit instruction do.

Webb, Tropper, and Fall, (1995) found that the number of occasions nor the amount of time students spent on interacting with classmates were not related to learning. What showed to be important was that, after receiving help, students would engage in constructive activity. Students who actually verbalized the work or tried to understand the explanation after receiving the help did learn more than those who did not do those things. Students' engagement in highly constructive activities (i.e., reworks or explains problems) after receiving help was strongly correlated to student achievement. Students who worked at the lower levels of constructive activities such as doing nothing or copying other's work were not very successful in solving new problems. They concluded that in order for students to actively engage in constructive activities, it was important to encourage individual students to seek explanations that they understand and to continuously work on a task until they could work on their own. The authors emphasized the importance of designing instructional interventions such as self- explanation prompts, which support constructive activity and suggest that students study the nature of explanations, which encourage constructive activities.

2.1 Knowledge Building in a Virtual Learning Environment

In virtual learning environment, the same problem emerged in recent studies on student interactions. Researchers pointed out that the lack of convergent interaction as a problem in a virtual learning environment (Chung, 1999; Harasim, 1990; Hewitt, 1997, Scardamlia & Bereiter, 1991). Often students merely browse WWW superficially and do not engage in thoughtful and active learning (Richtie & Hoffman, 1997). Students engage readily in divergent processes of knowledge building but needs help in the convergent processes (Chung, 1999; Harasim, 1996, Scardamlia & Bereiter, 1991).

To promote the facilitation of convergent knowledge building processes in a networked learning environment, researchers suggested the following approaches: developing support tools, such as concept maps (Harasim, 1990; Harasim et al., 1997); using linear message systems while rejecting threaded message systems; and developing a networked structured message which can provide easy access to other students' displays of ideas and their relationships (Hewitt, 1997). These approaches would be helpful in developing a system which students would find easy to use in building their knowledge. However, those tool development approaches would not be able to help students to be conscious about their learning processes and to monitor their knowledge building processes. In addition, those approaches would not be able to support students to learn to seek for explanations, which they can understand or to learn to continuously work until they can figure out the problems.

Another approach, which would facilitate seeking explanations and monitoring learning processes is designing the explanation prompts as suggested by Webb et al. (1995). I developed support tools, which would extend the use of prompts not only for explanation but also summarization and planning/monitoring to facilitate active learning in a virtual learning environment.

3. Support Tools

I developed prompts to support three activities, namely, summarizing, explaining, and reflecting. I selected them because these three activities would activate individual background knowledge. For instance, self-directed summarizing helps in knowledge construction by enhancing student comprehension of the lecture and at the same time by having them check their own comprehension (Palincsar & Brown, 1984). Self-explanation and self-regulation activities foster knowledge construction and problem solving performances (Bielaczyc et al., 1995). Finally, reflective activities include monitoring comprehension and learning activities, and clarifying and addressing failures in comprehension.

In asking students to summarize the lecture specifically, I had them identify the main ideas and elaborate their relations to one another. This procedure is related to exploring for new information and identifying the main ideas of the knowledge building process mentioned earlier. Then, in asking students to explain concepts using concrete examples and to connect these concepts to main ideas, I asked them to interpret the lecture, and to analyze and critically evaluate the ideas in the lecture. This process is related to analyzing and evaluating the relevance of knowledge building. Finally, reflective activities asked students to plan and monitor their own comprehension of the lecture and learning activities. This procedure is related to identifying the purpose and planning and monitoring of the knowledge building process.

4. Experimental Study

The purpose of this research was to study how support tools facilitate knowledge building processes in a WWW-based virtual university engineering course. Specifically, the first objective was to examine whether students engage in different types of knowledge building activities in when they use support tools. The second objective was to assess the effect of support tool use on student performance.

For the study, a quasi-experimental study was designed. An undergraduate engineering class of a virtual university was selected as the research site and students were randomly assigned two different environments: 1) without support tools, and 2) with support tools.

Research Questions

1. How do students using the tool to support their learning in an electronic learning environment differ in the knowledge building processes?
    - Hypothesis 1.a: Students will show different participation frequencies in online group discussion between students with the support tool and those without.
    - Hypothesis 1.b: Students in the treatment condition with the support tool will engage more in convergent interaction than students in the control group without the support tool during online group discussion.
2. How does the tool supporting learning in an electronic learning environment promote knowledge building?
    - Hypothesis 2.a: Students using tools to support their learning in an electronic learning environment build more integrated knowledge (number of cited principles, examples, evidences and

other sources).

4.1 Setting

An undergraduate engineering course on "Introduction to the Internet", for Fall 1998 at a big Midwestern Virtual University was selected as the research site. Students learned about broad aspects of the Internet such as the History of the Internet, Internet tools, Design of Web pages, and other technical topics. I created a group activity and the instruction for the two week period of the "Design of Web pages" unit. In the unit, the students' tasks were as a group to discuss and write the strengths and weaknesses of two different university homepages and to write recommendations on how to improve one university homepage. A group leader was assigned as a moderator to coordinate and facilitate the group work. There were online support of TAs and instructor whenever students encountered technical problems. Electronic shared work space was supported by program called "Web-talk". The Web-talk is a group online discussion tool, developed by the virtual university, in order for students to work together by planning and discussing their work online.

4.2 Data Collection and analysis

The participants were college students who were enrolled in the virtual course 'EGRXXX' in Engineering. For the treatment group, We developed cognitive support tools which prompt students to use the learning strategies such as planning/monitoring, summarization, and explanation in the virtual class. For the control group, no cognitive support tools were provided.

Data collection

Four kinds of data were collected in this study: pre-survey responses online, archived communication data online, group project data online, and post-survey responses online. The student responses to both pre-survey and post-survey were submitted through web, and the data were collected online. The online pre-survey was administered in the beginning of the semester and the online post-survey was administered after the lecture unit, "Design Workshop". The online survey data were later coded to SPSS. The communication data among students in the online class and the group project data for the "Design Workshop" were automatically archived in the Web-talk (a group communication tool developed for the virtual university), and the archives on the Web-talk were used as my data. Student interaction data and the group project data were taken from the archives of the Web-talk.

Coding

Interaction patterns examine the pattern of online participation among students. We used the 3 distinct features of knowledge building: reflection, divergent knowledge building, and convergent knowledge building. The pattern of participation, thus, was coded into three kinds: planning and monitoring, divergent knowledge building processes such as self-introduction such as idea sharing, and convergent knowledge building processes such as agreeing or disagreeing between different ideas, synthesizing ideas in writing.
Performance was measured by the quality of the student's two reports (comparison of the two university web pages and a recommendation). The reports submitted as the product of the group project were analyzed and scored to measure how much different ideas and concepts from the lecture were integrated in the recommendation letter.

Data Analysis

To answer the research question 1, descriptive statistics was used to compare the frequency and patterns of discussion participation between the 2 groups. One tail T-tests was conducted between the two groups with alpha level at 0.05. For the research question 2, one tail t-test was conducted with alpha level at 0.05.

5. Results

Research Hypothesis 1.a (about Participation Frequency)

There was no significant difference between the control group and the treatment group in participation frequencies. Students in the treatment group did not participate more frequently than that of the control group. In the categories of idea sharing and individual writing, the control group posted more messages, even though the difference is not big enough to be significant. In the categories of planning and convergent interaction, the treatment students posted almost twice as many messages as the control group.

Research Hypothesis 1.b (about Convergent interaction)

The difference between participation level in convergent interaction between the treatment and control group, was not statistically significant ($p<0.05$). Students in the treatment condition used a statistically significantly (alpha=0.1) higher number of shared concerns during their group interactions. The researcher interpreted this result to mean that in the treatment condition certain themes emerged from online group discussion and students were more engaged in their knowledge building than in the control group.

Research Hypothesis 2.a (about integration of knowledge)

There was significant difference between the treatment and control group in the level of integration of concepts represented in the group reports. The treatment group integrated more concepts, examples, and evidences in their project writing than the control group. There was a significant difference between the treatment and control groups in the levels of integration and elaboration of concepts in the group reports ($p<0.05$). The treatment group used more concepts, examples, and new ideas in their project writing than the control group.

This result supports my hypothesis that students who use the support tools which prompt them to summarize the lecture, explain the concepts, and reflect on what they need to know and what they need to plan to do the group tasks, would build more integrated knowledge than students in the control group, who did not receive any prompts.

6. Conclusion

This study conclude that the support tool use as well as group interaction enhances their engagement in knowledge building, especially knowledge integration such as their report writing in the online virtual university learning environment.

This study finding suggests that the high frequency of group interaction itself is not enough to promote student knowledge building, such as coordinating their group work and bringing different ideas together. While the interaction frequencies of students in both treatment and control groups were almost same, students in the control group, who engaged in group interaction, only reported their divergent knowledge building experience. Moreover, compared to the treatment group, less integration of knowledge occurred in the control group. In other words, students in the treatment group, who had the opportunity to engage in group interaction, as well as using summarization, self-explanation, and planning/monitoring prompts, engaged in more convergent knowledge building experiences and integrated more concepts and examples than student in the control group.

From the study, we can recommend to design support tools to promote student convergent knowledge building and higher knowledge integration in a virtual learning environment. This study finding indicated that the group of students who used the support tools of summarization, self-explanation, and planning/monitoring experienced convergent knowledge building and integrated knowledge more than the group of students who did not use the support tools.

7. References

Bielaczyc, Pirolli, Brown (1995), Training in self-explanation and self-regulation strategies: investigating the effects of knowledge acquisition activities on problem solving, Cognition and instruction, 1995, 13(2), 221-252

Chan, Burtis, & Bereiter (1997), Knowledge building as a mediator of conflict in conceptual change, Cognition and instruction, 15(1), 1-40

Chung, SeJin (1996), Cognitive processes of information seeking using WWW, Presented at the Annual meeting of AERA .

Chung, SeJin (1999), Participation patterns of student in a WWW-based virtual university class, Accepted as a paper presentation at the AERA Annual Meeting, Division C, 1999

Davis, E. (1998). Scaffolding students' reflection for science learning, University of California, Berkley

Ertmer and Newby (1996). The expert learner: Strategic, self-regulated, and reflective, Instructional Science, 24, p. 1-24

Harasim, Linda M. (1990), Online Education: An Environment for Collaboration and Intellectual Amplicfication. *Online Education: Perspectives on a New Environment*, Harasim, Linda M (Ed), New York, Praeger Publisher, pp. 39-66

Harasim, Linda, Calvert, Tom, Groeneboer, Chris (1997), Virtual-U: A web-based system to support collaborative learning, *Web-based instruction*, Khan, Badrul H (Ed), New Jersey, Educational Technology Publication, Inc., pp. 149-158

Hewitt, Jim; Scardamlia, Marlene (1996), Design principles for the support of distributed processes, Paper presented at the Annual Meeting of the American Educational Research Association, N.Y., http://csile.oise.on.ca/abstracts/distributed/???

Hewitt, Jim (1997). Beyond Threaded Discourse. Paper presented at WebNet '97, http://csile.oise.on.ca/abstracts/ThreadedDiscourse.htm

Palincsar and Brown (1984), Reciprocal teaching, Cognition and instruction, 1(2), 1984 spring, 117-176.

Ritchie, D. C, Hoffman, Bob (1997), Incorporating instructional design principles with the World Wide Web, *Web-based instruction*, Khan, Badrul H (Ed), New Jersey, Educational Technology Publication, Inc., pp. 149-158

Scardamalia, M., & Berreiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *The Journal of the learning sciences*, 1(1), 37-68.

Webb, N. M., Tropper, J. D., & Fall, R. (1995). Constructive activity and learning in collaborative small groups. *Journal of Educational Psychology*, 87(3), 406-423.

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Online School Performance Reports: Grading the Schools, Giving Citizens Data for Reform

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Abstract: For over two-thirds of the public schools in the United States it is now possible to see a report on school performance over the Internet. Such reports can include student demographics and performance, teacher qualifications and salary levels, funds expended per pupil, and sources of funding. Often, bases are offered for comparing a school with other schools with similar student populations, or financial resources, or from similar locations.
We examine the factors that have made this aggregation of readily-available information possible: a national drive toward education reform; the widespread availability of computers and the Internet in school systems; and advances in methods for collecting, sharing and displaying information. The paper also summarizes policy trends and changes in the ongoing national debate about schools that the availability of these reports will make possible.

Over the past ten years, with little fanfare, a very special sort of information revolution has been coming about in public education in the United States. For over two-thirds of public schools in the country, it is now possible to examine over the Internet a report card stating how students are performing and how qualified are their teachers, often displaying the moneys spent to achieve this performance level. Frequently we can compare one school to another, or to one of various regional, demographic or state averages.

The confluence of several factors has made online school performance reports possible. The most notable of these is the drive toward education reform, which has renewed interest by parents, administrators, policy makers, and concerned citizens in how schools are doing. Given the motivation, technology has provided the means: widespread Internet access; and the development of World Wide Web technologies for displaying and sharing information in a platform-independent manner.

The availability of this information, and the debates that should result on school issues, imply significant changes for U.S. education. It will certainly change how we talk about schools and what we expect of them – it is already doing so. It may not be excessively optimistic to expect this kind of open disclosure to extend itself to other areas of government and public service: the questions that we can and do now ask, but didn't before, are novel and fundamental.

A preliminary estimate (based on school year 1996-1997 data[1]) is that building-level report cards are available online for just over 70 per cent of the nation's public schools in 28 states. More state education systems are producing these reports, and it is only a matter of time until they too are placed online. It is only a question of time before an online report card is available for every school in the nation.

Perhaps most interesting is the participation of private enterprise in this disclosure effort. For example, the New Jersey school report card site was developed and is maintained by the Philadelphia Inquirer, although the data are collected by the New Jersey Department of Education (see http://www.phillynews.com/packages/njschools/).

Describing a "typical" school performance report

Although they vary widely, there is a common kernel. Consider the 1998 school report for Kalkaska Middle School in Kalkaska, Michigan, in the Traverse Bay area. The report includes three years of student performance data, mean teacher salaries (but no information on teacher credentials), school accreditation information, and financial data – a snapshot (actually, a three-piece short film) of the school. It shows trends over time (in this case, general increases in 7th grade math and reading percent satisfactory, and increases in 8th grade science percent satisfactory but decreases in 8th grade writing percent satisfactory). For demographic context, the report provides the percentage of individuals who receive either free or reduced-price lunches through the school.

Other sites provide more information on teacher education levels and certification – for example, in New Jersey the percentage of teachers with a Master's degree or more. Other states also provide a variety of comparison possibilities, either to statewide averages or to schools with similar demographic characteristics. In a couple of states (California and Massachusetts), data are provided on the availability of technology in the schools. Performance reports are provided for school districts, and also for entire states.

Student data in school report cards shows a national shift, from nearly exclusive dependence on norm-referenced measures toward criterion-referenced measures adapted to, or derived from, state content or performance standards. This is part of a broader reform and accountability trend, and we discuss the trend and its implications later in this paper. For now we will simply mention that performance-based measures have a face validity that norm-referenced tests lack, but in return criterion-based measures lack direct comparability across state boundaries[2]. Also given are the basic demographic facts of the school's student population, including one or more estimates of poverty levels in the school (or its district's) coverage area. A final piece of information provided at upper secondary levels concerns dropout and completion/graduation rates.

Teacher data are most often given in terms of teacher educational background, experience and certification levels; less frequently information is presented on school accreditation.

Finally, we add school finances. The basic cost unit is the cost per student full-time equivalent (FTE), which is accounted for in a variety of ways. Revenues are often given in terms of the local tax base, or presented with state contributions as a fraction of the total.

Some systems integrate these numbers into school performance values. Composite scores are generated by state performance systems in Kentucky and North Carolina. These numbers have disadvantages from the viewpoint of citizen understanding and information, but they have one overwhelming advantage: they allow decisions to be made. While multiple numbers, some of which go up over time and some of which go down, are susceptible to argument, single numbers can be incontrovertible – they either are larger or smaller. The disadvantage to the average citizen is loss of face validity, leading to difficulties of interpretation. A composite score can be difficult or impossible to interpret if it is based on weighted numbers from completely different areas, such as student performance and finances. Systems such as those in North Carolina and Texas compensate by basing their performance evaluations primarily on student performance. They set as targets a given proportion of students at or above grade level, say 50 or 70%.

Measuring student performance and holdings schools accountable

It is a simple step to move from developing target performance levels and measuring student performance against these targets, to creating accountability systems in which good performance or improvements over time are rewarded, and sanctions are created for remaining at less-than-satisfactory levels. By the author's informal count, there are accountability systems in place or being implemented in eight states: Alaska, Florida, Indiana, Kentucky, Mississippi, North Carolina, Ohio, and Texas.

The Texas Academic Excellence Indicator System (AEIS) serves here as a model for discussion. It is based on a criterion-referenced testing system, the Texas Assessment of Academic Skills, developed, reviewed and revised by many constituencies across the state over a period of years. As issues have been raised, they have been dealt with; for instance, concerned about differential levels of test-taking in different regions and the possible impact on performance evaluation, the state has made special efforts to create versions of the TAAS for students of limited English proficiency and for students in special education. Schools are given overall ratings. Schools and systems unable to improve risk various penalties, up to takeover by the state.

The reward system is much more visible than the sanction system. Schools showing marked improvement or achieving high performance levels are given "merit badges," such as inclusion on lists of "schools of excellence" or "schools of distinction." (North Carolina)

Some systems (Kentucky) establish complex rules for generating composite scores. These systems may provide more complete and comprehensive ratings of school and system performance, but they pay for this in being hard for the average citizen to comprehend. Such rating systems serve administrative purposes within the educational system, rather than public governance functions.

Changing what we know about schools, and how we talk about it

In any case, the dialogue about school issues has already been altered. The issues raised by performance-based systems are highly central to strongly-declared purposes of education: rates of completion of standards-based performance by high school graduates, for instance. In Texas, 70% of all students must complete the high school exit exam, which is first given in the tenth grade and taken until it is passed. Every high school's performance is measurable by this (admittedly, minimal) standard, and so is the performance of the school system of which it is part. Suddenly, dialogue about "how schools are doing" deals with an issue that all citizens recognize as of vital personal importance (after all, it is easy for those not college-educated to dismiss statements about excellence based on SAT scores or college admission rates). And the Texas system proposes to raise the passing percentage in the coming years.

To borrow a further point of discussion from the Texas setting, the dialogue about who takes the test has shifted the focus of conversation and action onto higher-risk populations: those with limited English proficiency and even students in special education. This brings everyone under the education tent for what may well be the very first time: all students now share the responsibility for the school's performance, and a school that wants to lift itself must deal with all of its students equally. If this principle can "stay the course," the consequences for education will be truly revolutionary.

With a dose of optimism, we can anticipate a more participatory community surrounding our public schools – quite the opposite of the viewpoints expressed with such pessimism just a few years ago. Ironically, opening the schools and school systems up, through technology, to public scrutiny, might increase rates of participation and involvement, or at least increase the rationality of argument.

Open discussion of priorities such as high school graduation with adequate preparation might well open the way to discussion of what "adequate preparation" might actually be. We might actually see alternatives presented for citizen consideration, and not simply isolated from public discussion by alienated constituencies.

References

[Clement et al., 1998] Clement, John, Shannon Blaney, Erin Massie, and Christine Welch. "Analysis of state performance reports." Unpublished document. Washington, D.C.: Education Statistics Services Institute, October 1998.

[CCSSO, 1996] Council of Chief State School Officers. "State Education Accountability Reports and Indicator Reports: Status of Reports Across the States, 1996." CCSSO State Education Assessment Center. Washington, D.C.: Council of Chief State School Officers, 1996.

[NCES, 1998a] National Center for Education Statistics. Statistics in Brief: Overview of Public Elementary and Secondary Schools and Districts: School Year 1996-97. (Publication 98-204) Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, October 1998.

Note: the opinions expressed in the paper are those of the author and do not represent the views of any Federal or state government agency.

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[1] This number is a first-order estimate. Building-level performance reports are available online for 28 states, which in 1996-1997 had a total of 60,464 schools. This represents just over 70% of the 86,058 schools reported for that

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academic year. See [Clement et al. 1998] for an analysis of performance reports by state; see [NCES, 1998a], table 1 for a count of schools by state for the 1996-1997 school year.

[2] Actually, comparability between states might be achieved where state standards are established by reference to national standards; however, alignment efforts of this kind largely remain to be undertaken.

Legal & Ethical Issues Related to Student Use of the Internet

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Abstract: Access to the Internet by students in elementary and secondary schools raises issues of censorship, the responsibility of schools *in loco parentis*, and the treatment of students as learners and future citizens. The Internet's ease of access and the volume of information available, as well as the difficulties of controlling access to information deemed undesirable for minors, has caused authorities to devise new methods of asserting control—or at least supervision. Some of these means may impose restrictions on the civil rights of students.

1. Internet usage in schools.

Student Internet usage is being limited by various entities—legislatures, school districts, software companies, and Internet service providers, to name a few. The forms of Internet usage (and consequent risks) vary by the educational contexts in which student access occurs. The level of legal protection varies, as well, according to the context in which the Internet is used.

The risk in any limitation is that students may be missing out on information that they have legal rights to access. This paper seeks to describe the legislative and filtering issues as they relate to students. The paper supports the contention that educating student users, not blocking speech, is the best policy to implement in schools. The paper also reviews case law on the rights of students to receive and disseminate information and attempts to exemplify corollaries between those rights and the case of Internet use. Finally, this paper seeks to preserve the rights at risk for students by suggesting alternative solutions for parents, educators and legislators to consider when creating policies that mandate students' educational futures.

2. Legislative Cyber- Solutions—Global legislative efforts, the CDA and COPA

The issues arise in the context of protecting students from the "inappropriate" material that can be accessed on the Internet by an unsupervised minor. In the United States, as well as in the European Parliament, the Japanese Parliament and the German Legislature[1], there has been discussion and debate as to the proper means by which to keep children safe and regulate the flow of information. U.S. Legislatures, both on federal and state levels, passed laws to address this protection of minors only to find, in some situations, that their laws could not hold under the strict scrutiny of the courts hearing them as First Amendment cases. The Communications Decency Act of 1996 ("CDA"),[2] which, most notably, subjected to criminal penalties of imprisonment and a fine, or both, anyone who created and initiated a transmission of material which was indecent or obscene, knowing that the recipient of such material was under 18 years of age, regardless of whether the creator of the materials placed the call or initiated the communication, was held to be vague and over-broad; therefore, it was found unconstitutional by the Supreme Court in June of 1997.

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[1] Kim L. Rappaport, Note, In the Wake of Reno v. ACLU: The Continued Struggle in Western Constitutional Democracies with Internet Censorship and Freedom of Speech Online, 13 *Am.U. Int'l L.Rev.* 765, (1998).

[2] Communications Decency Act of 1996 ("CDA"), Pub. L. No. 104-104, 47 U.S.C.A.223 (West Supp. 1997).

Last October, Congress passed the Child Online Protection Act ("COPA" which more narrowly tailored the concept written into the CDA. COPA imposes criminal and civil penalties on persons who "knowingly and with knowledge of the character of the materials, in interstate or foreign commerce by means of the World Wide Web, make any communication for commercial purposes that is available to any minor and that includes any material that is harmful to minors."[3]

These laws do not pass muster not only because they unduly restrict speech, but also because courts feel that laws passed in the United States, for example, will not be effective in other countries and that without a unified, global rule, there can be no effective protection. Without an effective method coming from legislatures to protect children and with growing concerns by parents and schools to limit access to resources deemed suitable for children, software designers found a demand in the marketplace and promoted their newly created blocking and filtering software. The software, distributed by a variety of private corporations, is designed to keep out certain information while allowing other information to be accessed. Filtering software, however, has lack of support as an effective method for protecting children:

The software, as well as the legislative activity of keeping inappropriate material from minors, has brought into question the rights of one particular sub-group of minors whose use of the Internet is especially crucial to their fundamental purpose—students. The rights of students to gain full access to the information available through the Internet, as well their rights to create and disseminate information over the Internet while they are in school, is at the very core of this debate, as restrictions would significantly affect this group's fundamental activities.

3. First Amendment Test Cases and Students, School Libraries, or Textbooks

The "First Amendment . . . does not tolerate laws that cast a pall of orthodoxy over the classroom."[4] While some states have passed laws or have bills pending to require filtering software on Internet terminals in public schools, there is still a question as to the validity of this sort of regulation, from a Constitutional perspective. It is critical to look at court precedent that has analyzed and interpreted the First Amendment of the U.S. Constitution as it applies to a student's right to disseminate and, more crucially, to receive information.

It is crucial that students' rights are kept in the forefront of decision making. However, the authors do not suggest that minors should be subjected to "inappropriate material" available on the Internet but rather that, given the present circumstances, filtering, monitoring and blocking devices are over-broad in their function and may deny students access to much needed information. Alternative forms of governance, such as proper guidance of ethical conduct, the imposition of classic rule, self-regulation and the fundamental tenets of contractual law, must be the solutions for protecting our children.

"[A] child merely on account of his minority, is not beyond the protection of the Constitution."[5] The First Amendment provides, in pertinent part, that "Congress shall make no law . . . abridging the freedom of speech, or of the press."[6] It is important to note that the right to free speech guaranteed to all Americans, via the First Amendment, is viewed as not only the right to send information but also the right to receive it. The rights of students come into question when students are denied access to certain content-based categories on the Internet via a school's policy. In the case of using filters to restrict access to the Internet, the policy would not hold as constitutional because there are many less restrictive means available. Designing an Acceptable Use Policy (AUP), using privacy screens, educating students on Internet use, placing time limits on use, monitoring use solely for counseling purposes, and enforcing disciplinary actions when Acceptable Use Policies are violated, are examples of these means.

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[3] 47 U.S.C. § 231 (a) (1). (The Child Online Privacy Protection Act also requires that Web site operators and online services operating Web sites directed to children obtain parental consent before collecting information from children under the age of thirteen.) *Id.* at § 231.

[4] *See id.* at 870 (quoting Keyishian v. Board of Regents, at 603).

[5] Bellotti v. Baird, 443 U.S. 622, 633, 61 L.Ed. 2d 797, 99 S. Ct. 3035 (1979) (plurality opinion).

[6] U.S. Constitutional amend. I.

First Amendment cases, decided in the context of other media also shed light on the validity of limiting Internet access and clarify student rights to Internet use. Court precedent reconfirmed and clarified student rights to receive information in a case called *Minarcini v. Strongsville City School Committee*. The court drew a distinction between information students obtained from textbooks and that from libraries. In Strongsville, the school would not allow certain books to be used in its school as texts or as library books. The court opined that, with respect to the issue of textbooks, there was no constitutional violation on the part of the school board. With respect to the library usage of the books, however, the court stated that the school board had less discretion to limit access:

> Neither the State of Ohio nor the Strongsville School Board was under any federal constitutional compulsion to provide a library for the Strongsville High School or to choose any particular books. Once having created such a privilege for the benefit of its students, however, neither body could place conditions on the use of the library that were related solely to the social or political tastes of the school board members.[7]

This court precedent can be paralleled to the rights a student has with respect to the use of the Internet. If the Internet use in question was in a library, or if the particular student use can be analogized to his or her use of the Internet as a huge digital library, then one could conclude that access to the sites and resources on the Internet, once provided, cannot be limited where the limitation may have been done solely for a school board's social or political tastes. If the Internet usage is to benefit from its infinite resources as a library in cyberspace, then the *Strongsville* argument can certainly be made

A similar factual scenario exists in the Supreme Court case of *Board of Education, Island Trees Union Free Sch. Dist. No. 26, et al. v. Pico*(*Pico*). It stated that "Our Constitution does not permit the official suppression of ideas"[8] and that a school does have a duty to inculcate community values, but that it does not extend to non-compulsory domains including a school library. The Court ruled that the school did violate the First Amendment in removing books from its libraries. The majority decision in the case established from the outset, however, that the case was limited in scope because it dealt only with library books and not textbooks. The distinction was made because library books "by their nature are optional rather than required reading."[9]

This case would allow us to interpret the discretion a school can have over controlling access to the Internet by studying the characteristics of the Internet and the way it is used. If the Internet is seen as a digital library and is used in a non-classroom, non-compulsory setting, then it would seem that the *Pico* situation would apply and would prevent schools from, in essence, "removing" material available on the Internet, by installing filtering software or by some other means of denying access. Where a school is using the Internet for classroom purposes, *Pico* suggests that a school may restrict its use. In a school library or as part of an extracurricular activity, it seems that a school's action to install filtering software would not hold constitutional muster.

Through the growth of case law that will evolve as more "censorship" laws are put in place and as blocking software is integrated into school systems, a new "wing" in First Amendment law will be created. The new body of law will, hopefully, reflect a greater understanding of specifically how the Internet works and how it is, at times, different from the textbook, the newspaper, and even the library.

4. Software Solutions—Why filtering is not the means to an end

When the Supreme Court found the Communications Decency Act unconstitutional last summer, they clearly indicated that it was the responsibility of schools and parents to protect young people from objectionable material.

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[7] Minarcini v. Strongsville City School Committee, 541 F. 2d 577 (1976).

[8] Pico, 457 U.S. 853 (1982).

[9] *Id.* at 862.

The job of "protection" the court suggested, could be done by the newly developed software programs that were designed to block out "objectionable" content from reaching minor students.

Who determines what is "objectionable," however, is an important question. Should it be the parents? The local school board or administration? Perhaps, the teacher who is most familiar with a student's particular information needs? Or, should it be a corporate third party, unrelated to the students and the community in whose environment the school exists? Americans have traditionally fought long and hard to protect their local control of schools. The infrequent, but still occasionally occurring, local book banning attests to this fact. Why then, is a nation of "rugged individualists" turning over control of what information enters the classroom to unknown distant corporate entities? What motivates filter manufacturers and distributors? Is it merely the profit motive and seizing the moment, or are there philosophical underpinnings to the filters? These and similar questions beg to be answered, especially so in view of questions about computer filters and their efficacy.

In January 1998, *Electronic School* devoted its cover to "Censorware, the Hard Task of Internet Safety." The author, Lars Kongshem, describes three ways in which filters operate: by keyword blocking, individual page blocking, and by rating systems. Keyword blocking searches text and images against lists of objectionable content. It frequently leads to mistaken identity or sometimes simply deletes offending lexical items from Web pages and delivers misleading text.

Blocking individual Web pages is another type of filtering. Providers create databases of objectionable pages, use them for their software, and license them to others. The problem lies in the fact that the Web is growing at far too fast a rate to allow software providers to keep up. This is exacerbated by filters' incapacity to efficiently separate the "undesirable" without also taking away that which may be "enlightening."

A third method of controlling access is the rating system. Rating systems are dependent on the entity that decides the ratings. Mr. Kongshem points out, "any system that depends on strangers to apply subjective ratings to …Web pages runs the risk of being out of touch with the local community norms." This, after 200 years of community control of schools, is disturbing indeed. Furthermore, the underlying philosophical bent of third-party ratings providers is another variable. What drives their selections? Is the philosophy compatible with that of the community, and is it reinforced by local mores and instructional practices or at odds with them? It is essential for communities to look at any filtering solution that they are considering before installing anything that lends outside influence to what their students can and cannot access. But is this the best solution?

Unnecessary censorship can be highly detrimental to students and their learning processes. One of the co-authors had first-hand experience observing the effects of censorship on her students in a society that has, for years, extended it to all media. Upon examination, it became obvious that this country had invested large sums in developing and implementing a sophisticated censorship system before the Internet became operational. Why then were two ordinary male students in a classroom able to enter a risqué lingerie site? The boys were looking for something and so they found it, even in the face of the massive effort that the local government had made to avoid exposure of its population to what it deemed morally offensive. Censorship had made the inappropriate material even more attractive to the boys. This is an obvious argument for training students in ethical decision-making skills. It is the province of the educational process (and the educators involved) to teach students how to discriminate among available materials and to make informed, ethical decisions about which material to choose.

The idea of "teaching" ethics is a tricky one, but it can and must be done. The scenario analysis method has always been a popular one in ethics training in both academic and corporate institutions. Lockheed-Martin, for example, has combined the scenario analysis method with both a cartoon character, Dilbert, and game playing. These are ideas that are attractive to students and might be adapted to teach computer ethics.

Jim Lichtman, an ethics specialist, has another method for training students. His book is called The Lone Ranger's Code of the West. Lichtman says that the Lone Ranger doesn't drink or smoke.[10] Could one extrapolate that he wouldn't access unacceptable material on the Net? There are any number of heroes who could be put in the Lone

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[10] [writer], Who is That Masked Ethicist?, The Washington Post, "" May 11, 1998; at D4.

Ranger's place to familiarize students with how ethics work. ROTC students use a book by Anthony L. Edler that includes Gene Autry's "Ten Cowboy Commandments."[11] These address topics like honesty, fairness, and Good Samaritan activity. This last topic was also addressed in the final Seinfeld episode. When a popular show like this gives its superficial, yet beloved, characters their comeuppance in the final episode, one might conclude that Americans want ethical, fair behavior and solutions to problems.

One way of dealing with ethical training and student empowerment that is gaining popularity with principals is the Acceptable Use Policy ("AUP"). An AUP is a written set of rules or guidelines for Internet use that includes sanctions to be enforced for breaking the terms of the AUP. Frequently, the AUP is a community effort and is composed by a team of administrators, teachers, students, and parents or other concerned community members. The AUP can be used as a teaching tool to develop ethical judgment skills in students, especially if they are involved in its development.

Limiting student access to the treasure trove of information that the Web can deliver might ultimately be as destructive as exposing students to objectionable material. Not enough of the right material could be just as damaging as the wrong material; however, placing the responsibility for self-policing must be preceded by ethical training.

5. Conclusion

Practices that have long been successful in dealing with children—clarity and consistency—are still appropriate with regard to the new technology. A community-developed AUP can be the vehicle for setting boundaries that protect minor children from whatever the community deems objectionable, while developing ethical decision-making skills in the next generation. AUPs can focus the responsibility for teaching moral judgment on the parents, who can choose to delegate it to teachers *in loco parentis*. Blocking and filtering simply substitute some corporation's judgment for that of the parents. These (inevitably) imperfect blocking or filtering mechanisms deny students the educational experiences that help them develop good judgment. If judgement is automated, where will students practice evaluating material and making informed judgments, as they will have to later in the larger world?

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[11] *Id.* at D4.

Analyzing a Successful Web-based Asynchronous Distance Learning Network

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Abstract: Distance education has been receiving a great deal of attention recently. Many courses and programs are now being offered at a distance. Under the distance education umbrella, Asynchronous Distance Learning Networks (ADLNs) are quickly growing in popularity and attractiveness to learners, teachers, and administrators. However, prior to implementing this type of learning environment, several important issues need to be reviewed and discussed. This paper reviews those issues and solutions that have proven successful in an ADLN that has been in existence for several years.

1. Introduction

As technology continues to advance in society and particularly in education, new opportunities become available to both learners and teachers. Many of these opportunities change the format of the traditional learning environment [Sherron 1998]. One of the most recent opportunities receiving a great deal of attention is distance education [Beekman 1997]. Distance education can mean different things to different people, but generally speaking it is thought of as the learning process where the learner(s) and teacher are separated by physical distance. This could mean the learner was physically located in another part of the building, city, state, or world than the teacher. Media such as two-way audio and video are used to allow the learner and teacher to communicate in "real time."

The type of distance education described above is synchronous in nature. However, this is not the only type of distance education available. A second and rapidly expanding type of distance education is asynchronous in nature. For purposes of this panel, this second type of distance education will be referred to as an "Asynchronous Distance Learning Network" (ADLN). An ADLN not only allows the learner and teacher to be separated by physical location, but also by time. In others words, the learner and teacher do not have to be present in any one location at the same time. The primary media used to establish this type of learning network is the World Wide Web.

Coupled with the flexibility afforded by synchronous distance education, ADLNs allow even more flexibility in the learning process. This additional flexibility provides many opportunities for students around the world to participate in the learning process when under the "traditional" learning environment they might not have been able to do so. These opportunities are particularly noticeable with non-traditional students such as single parents and others who juggle many responsibilities including full-time employment, families, and school.

2. Analyzing a Successful ADLN

As ADLNs become more attractive to educators and trainers, several important issues need to be discussed and considered before implementing this type of learning network. This paper will be devoted to reviewing those issues and solutions that have proven effective in a successful ADLN. This successful ADLN has been delivering instruction completely asynchronously primarily using the World Wide Web for over five years. The ADLN has approximately 250 students located throughout the world. Some of the most important issues that will be discussed by the panelists include:

- The design and presentation of course materials
- The type of media used in a Web-based environment
- Student/teacher interaction
- Student access
- Student assessment
- Handling large numbers of students
- Marketing
- Advising students
- dministrative support
- chnological support for both students and teachers

3. The Design and Presentation of Course Materials

A teacher in a Web-based ADLN will need to have special skills in order to prepare the course materials for presentation. Some of these skills include the creation of Web pages, video editing, and the use of asynchronous conferencing software. Additionally, course materials can be presented in many different ways in an ADLN environment. Some of these include lectures, assignments, activities, and case studies.

It is important for a teacher to be familiar with the skills required for preparation and the options available for presentation of those materials. In some cases, there will be support personnel that can assist a teacher in designing and developing the course materials. This support can be a lifesaver for those teachers with limited experience with technology and/or instructional design. However, even with technological support, teachers need to quickly develop proficiency using asynchronous conferencing software to be able to carry on interactive discussions with their students.

4. The Type of Media Used in a Web-based Environment

Traditional course materials can consist of many different types of media and can be presented on many different communications channels (i.e., voice, computer, video, etc.). This is also true with Web-based ADLNs. However, due to constraints associated with current technologies certain types of media and channels work better than others. Some of the more successful media include streaming audio and video, asynchronous conferencing software, text and graphics.

Streaming audio, video, and animation are an Internet-based information delivery system that provides "on demand" media materials. In general, digitized audio and video files are quite large. They can take a long time to transfer from a source on the Internet to the user, and then they take up a large amount of storage space on the user's computer until they are played and deleted. Streaming media addresses both of those problems through the use of special software at both the delivery and recipient ends.

When the user's computer "requests" a certain media file from a serving computer, the two machines remain connected while a compressed version of the digitized file is sent from the server to the user's machine. Software at the user's end immediately plays the media file without having to save it to storage. Because such files are compressed (think of a motion picture film that has every second or third frame removed), the end product is not going to have the same high quality as the original. But it is a way to provide video and audio materials on demand, from one Internet user to another--anywhere in the world.

5. Student/teacher Interaction

As in a traditional classroom, student/teacher interaction is important in a Web-based ADLN environment. However, it can be challenging to develop and foster this type of interaction due to the separation of both physical location and time. This is where asynchronous conferencing software becomes invaluable to the process. There are many different "brands" of this type of software, but essentially they have similar functions. They allow individuals (learners and teachers) to post messages and reply to messages on the Web. Each of the "strands" of messages is visible to the class members to read and comment upon. Each strand becomes an interactive conversation between members of the class. A teacher can monitor the strand making comments when deemed necessary. Many teachers feel this gives them the opportunity to move from the "sage on the stage" role to the "guide on the side" role.

There are several keys to the success of this type of student/teacher interaction. Possibly the most important involves the structuring of the initial question or case study. If the initial question is open-ended and provocative it can generate a lively debate. Teachers should avoid initial questions that involve a one or two sentence standard response, which will be the same for every student. For example, a poor first question would be "What are the main pieces of hardware in a computer?" This type of question would elicit the same basic answer from each student. There would be little or no interaction among students and the teacher. Better initial questions might be "If you could build a better computer, what pieces of hardware would you use? How would you use them and why?". These questions are more open-ended and allow students to share their ideas with other students and the teacher. They can also comment on other student's ideas and begin an online interactive discussion.

6. Student Access

The ability of students to easily and effectively access Web-based instructional materials is becoming increasingly important. If students have difficulty accessing the instructional materials the overall effectiveness of the learning experience will be diminished. Issues associated with this topic include hardware requirements, software requirements, internet service provider requirements, and technology support personnel.

Establishing such standards often means balancing the needs of the course provider (especially, the ability to use new technology) against restraints imposed upon members of a diverse student body (the cost of hardware and software, differing availability of Internet connectivity, individual levels of computer literacy, etc.). In general, this is accomplished by determining two sets of standards: one that will give the student optimal results, and one that will give the student adequate--if marginal--results. Students are encouraged to meet the highest level of standards early on, with the expectation that only minimal upgrades will be required for that student's access to stay within at least the "adequate" range throughout the two-year cycle of the degree program.

7. Student Assessment

Many people perceive one flaw in ADLNs. That is student assessment. The question is often asked, "How can you test a student who you never see?" This is a legitimate concern for newcomers to ADLNs; however, there are options available that meet most requirements. These options include using an electronic portfolio of assignments for assessment purposes. These assignments can be prepared using software like Adobe Acrobat and sent to the teacher as an e-mail attachment. Once received, teachers can attach written comments to the electronic documents and even highlight sections of the document if desired. In practice, there can be very little difference between the type and method of written feedback provided in a traditional classroom and that provided in an ADLN using software like Adobe Acrobat.

If teachers choose not to use software like Adobe Acrobat, assignments can also be posted on the Web. The assignments can be graded and then comments can be sent back to the student in an e-mail message. If this type of assessment does not meet the needs of the situation there are other options including Web-based online testing and the use of an off-site proctor. Both of these options have been used successfully in different situations. The type of assessment used depends on the situation. However, the necessary tools are available to successfully collect student's assessment.

8. Handling Large Numbers of Students

The attractiveness of a good course offered in an ADLN environment can result in a large number of students from around the world enrolled in the course. This can be troublesome for teachers when they have classes much larger than they are accustom to accommodating. This can be handled in many ways including breaking up the class into sections and providing section leaders. The teaching requirements can then be divided among the course instructor and section leaders. For example, the course instructor could carry the responsibility for course material preparation and presentation as well as grading. While the section leaders could maintain the online interactive conversations. This type of organization can result in slightly higher costs, but the quality of the educational experience can be greatly enhanced.

9. Marketing

In an ADLN, matriculated students are no longer limited to those who can physically be present in the classroom. This opens the door to many new opportunities for educational institutions to provide instruction to an international body. For this to happen, a well conceived marketing plan must be established. The plan should be made up of several phases including identifying demographics, identifying key information providing resources, evaluating the available options, preparing and running advertisements, and collecting feedback for evaluation and revision. Once a high-quality course or program has been successfully delivered at a distance, there is no reason why student enrollments cannot be dramatically increased through well-conceived marketing plans.

10. Advising Students

When working in an ADLN environment, student advising can sometimes be challenging. One way of handling this is to create a "frequently asked advising questions" (FAQ) list and posting it on asynchronous conferencing software or as Web page(s). The initial investment of time needed to create this type of list can be well worth the effort in the long run because students will become accustomed to looking at the FAQ list before asking someone a question. FAQ lists should be periodically reviewed for their accuracy and timeliness. A way of handling advising is to utilize e-mail and attachments as discussed previously. Finally, phone support for advising is a great supplement to asynchronous means of communication. A synchronous phone call to a confused student can go a long way toward putting them on the right track. No matter how it is handled, advising is just as important in an ADLN as it is in a traditional learning environment.

11. Administrative Support

In an ADLN environment, administrative support is crucial to the success of a Web-based academic program. This includes support for both students and teachers. Because students (and sometimes teachers) are located throughout the world, the traditional face-to-face administrative support is not available. Administrative support at a distance takes on new meaning and importance. The use of "Frequently Asked Questions" Web pages and continual monitoring of e-mail accounts becomes significant and time consuming. Some other important issues associated with this topic include responding to general program informational inquiries, admissions, registration, transfer of credits, budget and phone support.

In general, administrative support personnel can act as a liaison between the distance education student and the various student service offices on campus: admissions, registrar, student accounts, the financial aid office and even the University bookstore. As the number of distance education courses increase at the university these student service offices will become accustomed to working with distance education students directly and the need for the "liaison" will slowly diminish. Many of these offices are beginning to post policies, contact information and administrative forms on the Web. Some of the offices have also agreed to accept credit card payments for tuition and textbooks over the telephone. Web-based registration for classes is already a reality. In the near future, students will also be able to access various aspects of their student records, and even submit "change of address" information directly on-line.

Some information that is currently posted directly to the web includes course registration and withdrawal procedures, requests for an "incomplete", test taking procedures, and graduation information. Other non-student administrative information that is posted on the web includes faculty hire forms, tax forms, and employee eligibility forms.

Because distance education students need timely responses to questions, on-campus work/study students are sometimes employed to assist with administrative support functions. In many cases they are the first point of contact with the program for a student's e-mail inquiry or a phone call. An enormous number of calls come into the program office and it is critical that these calls and inquiries be sent to the right person for a response or handled without a referral. The questions are usually very simple to answer, yet the job can be very time consuming. Most of the questions occur during registration times concerning classes, billing, registration problems, etc. The administrative support work done behind the scenes may not have the most direct impact on student learning or get much publicity, but it does promote student success.

12. Technological Support for both Students and Teachers

The quality and timeliness of technological support for both students and teachers cannot be understated. It will make or break a Web-based ADLN. A poorly designed or implemented technological support plan will directly effect the learning environment. This not only includes the understanding of various technologies, but how they can be effectively used in an ADLN. Some of the important issues associated with this topic include maintaining an e-mail and phone help desk, maintenance of servers and accounts, streaming of audio, video, and animation, and exploration of new technologies.

Key to effectively supporting students and teachers is first determining that new students and faculty have the fundamental computer literacy skills necessary to participate in a distance education program, then training them to use the specific tools implemented by that program. This must be accomplished before the semester has begun.

Since asynchronous distance learning programs are especially attractive to working adults, care must be taken to provide technical support during the times that students are most in need of support services. This includes evening, weekend, and holiday hours. From the student's standpoint, little is more frustrating than to plan a weekend devoted to coursework, only to have those plans cancelled because a technology "glitch" could not be resolved until the beginning of the following work week. Because such frustrations can easily build to the point that a student may feel that they are incapable of learning at a distance, the support structure must be available during non-traditional work hours.

13. Conclusion

ADLNs are growing in popularity and attractiveness to learners, teachers, and administrators. Before implementing this type of learning environment, several important issues need to be reviewed and discussed. They include the design and presentation of course materials, the type of media used in a Web-based environment, student/teacher interaction, student access, student assessment, handling large numbers of students, marketing, advising students, administrative support and technological support for both students and teachers.

14. References

[Beekman 1997] Beekman, G. (1997). *Computer confluence: Exploring tomorrow's technology.* New York, NY: Addison Wesley Longman, Inc.

[Sherron 1998] Sherron, G.T. (1998). In support of distance learning. *Syllabus*, 11(7), 44-47.

When the Learner is in Charge: Student Technological Literacy Patterns

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Abstract

The study examined technological literacy patterns and the process of inquiry in a student-centered summer program designed around student research and Internet use. Five case studies consisted of various configurations of fifth grade students from a variety of educational backgrounds. A qualitative approach to research was implemented using grounded theory and the constant comparative method of data analysis. Date in the form of observational field notes, transcripts of video and audiotapes resulting from each of the daily sessions revealed interesting findings regarding emergent technological literacy, "computer talk," work patterns, and the process students followed as they conducted technology-assisted inquiry. Pronounced differences between male and female participants showed variation and specific preferences to project design, inquiry, Internet usage, and group configurations. Results of the study are offered to classroom teachers as implications for instructional practices in computer-enhanced classrooms.

Current Practices in Classroom Technology

The tools human beings have for obtaining information and solving problems have drastically changed across the century. Innovations in the areas of occupations, transportation, and communication—due to technology—have had an enormous effect on education. The urbanization and industrialization that so attend the American way of life that began in the early part of the century continues today. In the forward to his futuristic book, Gates (1995) suggests that we are beginning another great journey. We aren't sure where this journey will lead, but it is certain to touch many more lives. The major change coming will be in the ways people carry out their jobs and communicate with each other. However, even though computers and various pieces of hardware are present in most, if not all schools, the cultural change accompanying earlier innovations has not yet taken place for technology in most classrooms today.

While visiting local schools and classrooms, it was observed that the small amount of equipment currently in classrooms is too often turned off, disconnected, or layered with dust. The teachers who are utilizing their machines usually structure computer time with programmed software, such as games or drill and practice packages. Computers—though visible—are not sufficiently in use and they are certainly not doing the job they could be doing. Technology for the most part remains on the periphery in many classrooms. Recent research has revealed that computers are still commonly, and sometimes only used for word processing (Grunberg and Summers, 1992; Downes and Fatouros, 1995). A large number of teachers remain apprehensive regarding computers and computer-enhanced instruction while their students continue to embrace new technologies in out-of-class settings making schooling appear even more useless and irrelevant to the lives of young learners. Still, computers are being purchased in large numbers by school systems. The availability of classroom computers has increased from approximately one computer for every 125 students a decade ago to approximately one computer per fifteen students today (Dryli and

Kinnaman, 1994). Networked computers are becoming as common as maps, globes, dictionaries, and encyclopedias in many classrooms. In addition, computers with Internet access are available for students to provide information and to assist them throughout the learning process.

In terms of student research and problem solving, the Internet-connected computer has the capability to take students far beyond the classroom. The amount of information each student can access is essentially infinite. Selecting, managing, and organizing this expansive amount of information is becoming crucial to the student learning process. With the level of comfort students display regarding technology, the enthusiasm they exhibit at the prospect of computer-time, and the availability of computers with Internet access, several questions surface regarding the process of examining what teachers need to know and how students can learn from being exposed to a school situation where: a) computers, b) the Internet, c) library resources, and d) a lab-type setting were available to assist with individualized student-generated inquiry.

Examining Technology Driven Student-Generated Inquiry Practices

As cited by Negroponte (1995), approximately half of what students learn is provided by teachers, however the other half comes from exploration, reinventing the wheel, and finding out for oneself. Until computers were introduced in schools, technology was limited to films, television, and other audiovisual devices which magnify the activity of teachers and the passivity of students (Dixon-Krauss, 1996; Negroponte, 1995; Papert, 1980; Solomon, 1987).

A synthesis of the works of Piaget (1932), Vygotsky (1987), and Cole and Wertsch (1995), conclude that in order for true learning to take place, a combination of active child and active environment must be present. This combination creates a "co-constructionism" which maximizes student learning and emulates a "learning-in-the-wild" environment. Students who are allowed to "construct" their own explanations in order to make sense of the world around them using what is for them new information and knowledge, learn how to learn and will be better fitted for life in the next century. The source of new knowledge should be available within an enriched classroom environment (Cole and Wertsch, 1995; Piaget, 1932; Vygotsky, 1987).

Furthermore, Papert (1996) suggests that our entire structure of school is primitive. Knowledge is cut up into little unrelated pieces and offered by a teacher who is commonly found in front of a classroom of passive students. Because of the new digital technologies of today—present but not being implemented fully in classrooms—a demand for a future workforce equipped with skills such as abstraction, systems thinking, experimentation, and collaboration, student-generated inquiry and Internet utilization is necessary. These are critical skills which are not understood by most educators and are not being taught or fostered in our classrooms (Goldberg and Richards, 1995; Reich, 1992).

Based on these assumptions, the purpose of the study was to examine, document, analyze, and provide a rich, thick, and dense description of how students access information and what organizational processes they employed while utilizing the Internet as they engaged in their own individual inquiry pursuits. Using a qualitative approach outlined by Bogdan and Biklen (1994), Strauss and Corbin (1990), and Guba and Lincoln (1985), the researcher became a participant observer in conducting five case studies consisting of upcoming fifth grade students selected from a purposive sample in a lab-type setting where they engaged in individual self-generated inquiry with the assistance of networked computers, peers, teachers, and all other resources available in the school and community. Data sets were collected through observational field notes, transcripts of video and audiotapes of each session, student journals, and photo essays. The project was constructed as a *Summer Technology Institute* and was offered at a local elementary school where parents frequently seek summer educational opportunities for their children. Observations and data collection spanned a four-week period. Library access and a collection of electronic research materials such as electronic encyclopedias, electronic atlas programs, and various other CD ROM programs designed for student research provided students with additional research material as needed.

Throughout the study the researcher delved into the essence of student action and interaction and attempted to convert "raw" experiences into insights and useful patterns. The following questions framed the study and provided the researcher with a set of overarching themes:

1. How do students use the computer and the Internet to assist in their own research and inquiry pursuits?
2. What patterns of technological literacy emerge as students engage in inquiry?

3 . What do teachers need to know and do to support these processes?

Findings and Conclusions

In reflecting on methods of research and the process an inquirer follows, Boyd (1961) writes that Charles Kettering once suggested that research is nothing but a state of mind, a friendly welcoming attitude toward change, and an effort to do things better. One of the initial questions that framed the study converged on what teachers needed to know in order to support student-generated inquiry and promote technological literacy. This question implied a focus on change. The change—aimed at common instructional practices—would provide students with an opportunity to engage in self-generated inquiry. In an attempt to offer classroom teachers insights into the process of student-generated technology-enhanced inquiry, general findings are presented in the chronological order in which they occurred. As data collection took place, the researcher recorded daily reflections as a means of gaining understanding as well as to compile a list of implications for classroom teachers. In addition to daily entries in an observational field journal, videotapes and audiotapes of each session provided additional information to aid in understanding the nature of student interactions with peers and computers.

The first major findings that emerged as early as the first pre-institute interview session was that students displayed an apprehension and shyness regarding sharing opinions and interests. The entire group sought teacher approval and were reluctant to grasp the freedom bestowed upon them as participants in the project. For example, during the first pre-institute session when asked, "What do you think would be important
enough to find out more about?" a student participant answered, "I'm just a kid. I don't know what's important!"

Another major finding was that after the second pre-institute sessions where students became familiar with the Internet, Netscape, and simple navigation, one could not differentiate between students who had prior placement in a technology-enhanced classroom—as defined by the state—and those who had no prior placement. In fact, those who were never in a technology-enhanced classroom in grades K – 4, were more apt to attack simple computer problems, conduct searches, and offer their "expertise" to others. There was some difference, however, between students who spent a large amount of time on home computers—up to two hours per day—and those who did not. With the exception of the one student with no computer in the home, students who spent larger amounts of time using their home computers emerged as "experts" in assisting other students, offering suggestions, and conducting in-depth searches. The emergent technological literacy these student brought from home had more of an impact on student processes and progress than the level of emergent technological literacy other students brought from experience within a classroom setting where computers were present.

Perhaps the most glaring finding was the distinct differences between male and female participants. Beginning with the first summer session, videotapes and field notes show that female students sought help from the researcher and teacher participant at a ratio of 14:1. Videotapes of the first session show that female students raised their hands for help fourteen times for every one time a male participant asked for help or assistance. Females did not leave their computers, but stayed in their seats while male students got up and walked to the researcher or teacher participant with questions. This of course enabled the male help-seeker to obtain assistance quicker. Male participants often sought help from other students whereas female participants would wait for the researcher or teacher participant.

Moving Forward With Technology

The project offered students opportunities to engage in self-generated inquiry, and utilize the Internet within a non-threatening, student-centered environment that promoted technological literacy and student research. Findings from the study show that students need a specific environment in order to thrive and develop the skills needed to operate in a technology-driven world. Time for thinking, conversing, and movement are essential in this environment. The ability to choose and select topics of interest, develop work patterns, and operate within a self-selected group configuration allowed students to move through the inquiry process naturally. Sharing, assisting, and offering expertise are essential components which must be present in a technology-enhanced classroom in order to provide students with optimal opportunities to engaged in Internet-assisted inquiry.

In order to better prepare today's students for the technology-driven world they will be part of in the future, educators must examine current instructional practices, past instructional practices, software purchases, and technology integration and implementation. The study showed that it made no difference how many years a student was placed in a technology-enhanced classroom. That experience had no impact on the inquiry process nor did it have an impact on any technological literacy patterns, work habits, or utilization of the Internet. However, the instructional practices, non-threatening environment, encouragement provided by the teacher participant, and the allowances made for each student's preferences seemed to have the most influence on the process. With the abundance of funds allocated for classroom technology, software, and computers, it seems that these things are essential in developing the type of classroom environment needed by students who will make up the future workforce.

References

Bogdan, R.C. and Biklen, S.K. (1992). *Qualitative research for education: An introduction to theory and methods.* _Boston: Allyn and Bacon.

Boyd, T.A. (1961). *Prophet of progress: Selections from the speeches of Charles F. Kettering.* New York: Dutton.

Cole, M. and Wertsch, J.V. (1995). Beyond individual and social antimony in discussions of Piaget and Vygotsky. [Online] Available: http://masey.ac.nz/~Alock/virtual/colevy.g.htm

Dixon-Krauss, J. (1996). *Vygotsky in the classroom: Mediated literacy instruction and assessment.* White Plains: Longman Publishers.

Downes, T. and Fatouros, C. (1995). *Learning in an electronic world: Computers and the language arts classroom.* _Portsmouth: Heinemann.

Dryli, O. and Kinnaman, D. (1994). Integrating technology into your classroom curriculum. *Technology and Learning, 2,* 38 – 44.

Gates, B. (1995). *The road ahead.* New York: Viking Press.

Goldberg, B. and Richards, J. (1995). Leveraging technology for reform: Changing schools and communities into learning organizations. *Educational Leadership, 18,* 5 – 16.

Grunberg, J. and Summers, M. (1992). Computer innovation in schools: A review of selected literature. *Journal of Information Technology in Teacher Education, 1,* 255 – 276.

Guba, E.G. and Lincoln, Y. (1985). *Naturalistic inquiry.* Beverly Hills: Sage Publications.

Negroponte, N. (1995). *Being digital.* New York: Vintage Books.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas.* New York: Basic Books.

Papert, S. (1996). *The connected family: Bridging the digital generation gap.* Atlanta: Longstreet Press.

Piaget, J. (1932). *The moral judgment of the child.* London: Routledge and Kegan Paul.

Reich, R. (1992). *The work of nations.* New York: Vintage Books.

Solomon, C. (1987). *Computer environments for children.* Cambridge: The MIT Press.

Strauss, A. and Corbin, J. (1990). *Basics of qualitative research: Procedures and techniques.* Newbury Park: Sage Publications.

Vygotsky, L. S. (1987). *The collected works of L.S. Vygotsky, vol. 1: Problems of general psychology.* _New York: Plenium.

ubiquity is driving organizations to move strategic business functions to the web as quickly as possible. Second, many people think web site development is cheap and easy, not realizing the great difference between a glitzy web page and a carefully designed WBA that supports a specific business function. The net effect of both forces is a very real pressure to compress schedules and keep development costs down. Under this pressure, a formal software development process may be the first thing sacrificed. However, the activities of such a process (planning, estimating, scheduling, monitoring, and reviewing) remain important for successful WBA development. *A WBA development process needs to include well-defined management activities, yet be unobtrusive; documentation and process overhead should be kept to the minimum necessary to preserve accountability.*

Another challenge is that, contrary to popular opinion, user interface development for the web is difficult. The users of web applications are potentially more diverse (in experience, age, language, and training, among other qualities) than is the case with most software applications. Furthermore, they are running applications on a variety of platforms and using functionally diverse web browsers. This increases the challenge of determining appropriate interface content and appearance, and makes early and frequent user review essential. *A WBA development process should produce a complete and functioning user interface as early and often as possible.*

A final challenge is that the stakeholders of a WBA are often geographically scattered, making frequent meetings impractical. As a minimum, these stakeholders include the developers, the clients who are commissioning the development, and the end-users of the system. *A WBA development process must promote success despite the lack of face-to-face interaction between the project's stakeholders.*

3 Process Description

We propose a lightweight development process that addresses each of the challenges described above. This process is based on our recent and successful experience with implementing a grant application system for the Federal Highway Administration (FHWA), National Scenic Byways (NSB) Program, as well as other previous WBA development projects. We provide an overview of the process below and describe our experience in Section 4. Related work is discussed in Section 5.

Our process model is similar to the evolutionary prototyping model which consists of cascading phases of interdependent waterfall processes. However, it differs from the evolutionary prototyping process model in several ways. Specifically, it involves just two phases instead of an undefined number. The first follows a modified incremental development model with an emphasis on rapid prototyping. The second follows a lean waterfall model with an emphasis on quality. See Figure 1. Our process also deals with poorly understood requirements early in the development life cycle; whereas, the evolutionary prototyping process is more likely to start off with well understood requirements [Davis et al. 1988].

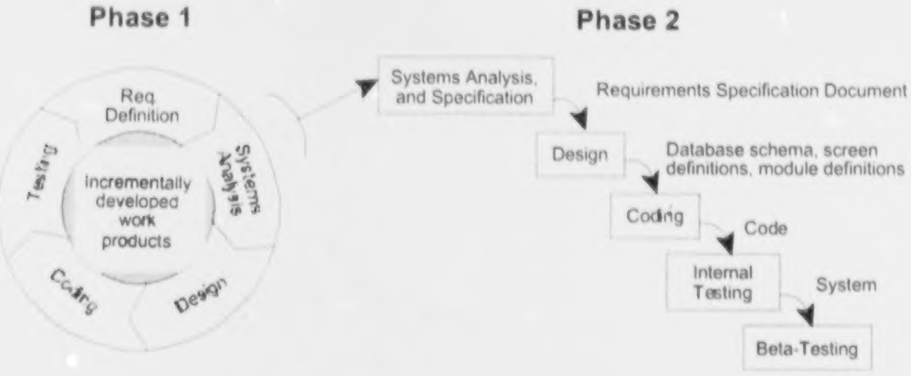
Phase 1
Phase 2
Req. Definition
Systems Analysis
Design
Coding
Testing
Incrementally developed work products
Systems Analysis, and Specification
Requirements Specification Document
Design
Database schema, screen definitions, module definitions
Coding
Code
Internal Testing
System
Beta-Testing

Figure 1: Overview of development process

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A Lightweight Development Process for Implementing Business Functions on the Web

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Abstract: From a software engineering perspective, moving a business software application to the web presents interesting challenges. These include frequent changes to requirements, changes to the underlying business function as a consequence of moving to the web, tight time and cost constraints, and producing quality user interfaces within the restrictions of the web environment. This paper describes a lightweight, two-phase process that integrates advantages from incremental development, throwaway prototyping, and waterfall process models to address these challenges. A successful development experience using this process is summarized.

1 Introduction

Businesses of all kinds are clamoring to migrate key functions to the web. As contract software developers, we have seen much of this development effort occurring in a haphazard and rushed manner, with little room for a formal process. This lack of management makes it difficult to plan a project, estimate costs, schedule resources, monitor and report progress, and review quality. A process must be established which can meet the unique challenges of developing quality software for the web in a timely manner. In this paper, we define a lightweight development process that does so and we describe our experience using it. We also generalize this experience for similar development projects.

2 Challenges of Developing Web-based Applications

Below are five challenges of developing Web-based Applications (WBAs). These challenges are not comprehensive and individually they are not unique to web development. However, in our experience, they do occur frequently and together in web-based applications. A WBA development process must be designed to deal with these challenges directly.

The first serious challenge concerns the difficulty of pinning down the requirements early. This is caused by several factors. At the start, the users may be unprepared or unwilling to abandon old methods in favor of new web-based processes. They may lack a vision of just how much the web-based application (WBA) can do for them. Consequently, as the user discovers what can be done, he or she adds requirements piecemeal throughout the entire software life cycle. This can lead to dramatic and frequent changes which ripple through every work product. *A process for WBA development must adapt to changing requirements.*

A related challenge is that the business function itself evolves as a consequence of migrating it to the web. As the user sees what can be done, he or she also begins to rethink the underlying business model. This also changes the developing WBA's functional requirements throughout the entire life cycle. One industry example is when revenue once generated from product sales is replaced by revenue from advertisements on a web page offering the products for free. *A process for WBA development must allow the underlying business function to evolve.*

Another challenge is that the severe time and cost constraints of typical WBA development often compel project teams to discard formal development processes. Severe time and cost constraints are nothing new in software development, but with WBA development, two forces make them even worse. First, the web's popularity and its

Phase 1 is based on a incremental process model and therefore involves the iteration of core development activities. However, it focuses on just five: requirements definition, systems analysis, design, coding and testing. Here, the requirements definition uses one-on-one conversations with the users to produce an outline of desired features. The systems analysis focuses on understanding the key entities and their relationships, interactions and behavior. It refines a model describing the existing business functions and their reincarnation on the web. Although any reasonable conceptual model language can be used, we prefer Object-oriented Systems Analysis [Embley et al. 1992] and Unified Modeling Language [Booch et al. 1999] for their expressiveness and solid foundations. The design activity includes high-level organization, user interface, and database design. It produces module specifications, screen sketches, and database schema. The coding involves programming, graphic artwork, and writing, and it produces incremental versions of the system with all the necessary icons, backgrounds, decorations, and on-line documentation. In some cases, particularly during early iterations, the coding is for prototypes that are intended to be thrown away and redone in later iterations. The testing focuses on both the validation and verification of the software system and is done at unit, integration, and system levels. During early iterations the programmers test their own work. In later iterations, team members test each other's work, and in the final iterations, the selected users participate. In all cases, the testing activities produce feedback for the next iteration.

The activities and work products of the first phase include only those which are essential to capture the core ideas, communicate with the customer, manage the project, and produce a usable product. Several common activities, such as system specification and detail design, are explicitly not mentioned in the process model. Although these activities can still be performed when appropriate, they are de-emphasized and folded into other activities. For example, some specification for defining high-level modules occurs during design and some detailed design occurs as part of coding.

The first phase is similar to a traditional incremental model in the way features are completed through successive iteration of the development cycle. It differs from the traditional incremental model in several ways. First, it is as lightweight and informal as possible and yet still produces a usable product with a well-defined, repeatable process. Second, the requirements during the first phase are more fluid than would otherwise be desired or allowed. Third, it integrates the notion of throwaway prototypes for high-risk features which are either poorly understood, have a large impact on the rest of the system, or are of particular importance to the client.

Phase 2 is based on a waterfall model and therefore consists of well-defined steps that correspond closely to development activities. Work products from one step become inputs for the next. Unlike the first phase, progress is measured in terms of completion of development activities, instead of the completion of features.

The first step of Phase 2 is system analysis and specification. This step will use the entire set of work products and experiences from the first phase as a basis for re-analyzing the system and coming up with a concise and accurate specification. The second step is design which produces module definitions, screen sketches, and database schema. The coding step implements the entire system. The testing step includes unit, integration, and alpha testing. The last step is beta testing which involves testing with a selected set of users. Like other waterfall processes, Phase 2 allows for feedback loops to correct problems and respond to issues raised during testing.

Like Phase 1, Phase 2 is kept as lightweight as possible. Some steps are intentionally excluded or folded into other steps. For example, requirements definition doesn't exist since the entire first phase serves that purpose. Also, system analysis and specification are combined and produce a single work product.

It is important to note that both phases are critical to the overall success of the development process. The first, more fluid phase is necessary because the process must be adaptable while all involved parties react to change. The second, more measured phase is necessary because it gives developers an opportunity to integrate the requirements found during the first phase into a more maintainable, extensible, and long-term architecture. Such qualities are not likely to be found in the first-phase product. Also, the second phase gives all parties time to complete the all-important mental and procedural shift to a web-based system.

4 Our Experience with the Process

The FHWA-NSB required a cost- and time-effective means of gathering and reviewing submitted discretionary grant applications. At that time, the submissions were paper-based and entered by hand into a single data table which was then used to generate the necessary reports. This old method took many man-months. We used our two-phase process above to develop a WBA to automate the entire discretionary grant application and award process.

Initially, our client, the FHWA, was reluctant to abandon the old method and switch to the new one. Many of our experienced end-users (associated with the state byway programs) also resisted the change. In addition, the FHWA was revising the older method even as we worked.

Our client was in Washington, D.C., we were in Utah, and our ultimate users were scattered throughout the U.S. Funding allowed for just one face-to-face meeting, so phone calls, faxes, and the Internet were the primary means of communication.

Time constraints were severe, especially for the 1998 grant program. The FHWA and the state byway agencies required delivery of a working product just seven weeks after assigning us the project so they could meet deadlines imposed by the legislature.

Our objectives for Phase 1 were:

1. produce a working product in time for that year's discretionary grant deadline
2. enable byway agencies to submit correct and complete applications
3. enable state and federal agencies to review them
4. start the transition from a paper-based system to a web-based system

Phase 1 began June 3, 1998. During the subsequent seven weeks, we iterated through the Phase 1 development cycle several dozen times. The early iterations took 2-3 weeks and focused on systems analysis, database design, and user interface design. The coding and testing activities during these early iterations resulted in prototypes that addressed specific analysis and design issues. Subsequent iterations focused on coding and testing, although some analysis and design activities continued as requirements changed. On July 6th, we held the first major review of the complete system with our client. This was followed by several more iterations of the development cycle, each concluding with an outside review. We froze the requirements for the final iterations so as to converge on a public release. These final iterations focused on polishing look-and-feel, terminology, and online help. The public release of the Phase-1 product was made on July 24th, one week before the legislative deadline. For unrelated reasons, the grant application deadline was moved to Aug. 7th. The final release contained sufficient features to enable the end-users to submit and review grant applications. Between July 24th and Aug. 7th, 38 different users submitted 83 grant applications online.

We tested the WBA with the team and FHWA. After the release, our end-users discovered several minor errors, one major error (a data field overflow with subsequent loss of data,) and one serious conflict between required functionality and software capability (printing multi-page, formatted documents within the limitations of browser software.) Most errors, including the major one, were fixed within 24 hours if not while the customer was online and talking to us. The resolution of the printing conflict and the correction of some cosmetic problems and navigational inconveniences were intentionally postponed to the second phase.

During the first phase, frequent review sessions with the client were essential. These review sessions had several benefits. They provided valuable feedback on the emerging software system. They kept us focused and on track. Finally, they helped the client envision how the web-based system could not only augment but supplant the paper-based system. This set the stage for the second phase.

Our objectives for Phase 2 included those for Phase 1, plus

1. solidify and refine user requirements
2. develop an extensible and maintainable system that can meet the FHWA's grant program needs for the next five years

3. complete the transition from a paper-based system to a web-based system

Phase 2 began Nov. 18 and 19, 1998 with a face-to-face meeting with the FHWA. This meeting was both a post-mortem on Phase 1 and a heads-down design session for Phase 2. After this meeting, database redesign took two additional days and user interface redesign one additional day. The design was completed by Nov. 31. A beta release was completed Dec. 18, which met and exceeded expectations. Beta testing was Dec. 28-31, and the product was ready to release Jan. 4, 1999. It lacked only help and examples to be supplied by the FHWA. The final product could not be officially released to the public until the FHWA announced the year's discretionary grants fund, which finally occurred Feb. 23. Between this release date and the June 30 deadline, 280 applications were completed, reviewed, and submitted.

During beta testing, testers found 16 errors and submitted 52 suggestions. Most of the errors were minor, such as spelling mistakes, formatting, and other cosmetic problems. Six of the suggestions were major, requiring additional functionality, or changes to the database scheme and user-interface behavior. Since the release, users and support personnel have reported 3 major and 7 minor errors.

Although the second phase was as time-constrained as the first (seven weeks, counting holidays), it went more smoothly. Schedules were kept, milestones met, and the reaction from the FHWA and end-users was, in general, positive.[1]

The amount of time spent in Phase 2 on requirements, analysis, specification and design was drastically reduced. In effect, Phase 1 embodied the requirements definition and systems analysis. The experience we gained during the hectic weeks of Phase 1 paid off in Phase 2. We gained a better understanding of the discretionary grant business function and developed a more comprehensive WBA in equivalent time. The FHWA switched from resisting a completely web-based application to enthusiastically supporting it. Even our end-users, having been exposed to the Phase 1 product, were better prepared for the Phase 2 product.

5 Discussion and Related Work

A strength of our two-phase process is that it directly addresses all the challenges stated in Section 2 without introducing unnecessary overhead or process complexity. Many existing process models successfully address some of the challenges, but not all five. For example, some formal processes have trouble reacting to the time and cost constraints of WBA development because of undue emphasis on lock-step activities and ancillary documentation.

Most of the concepts found in the two-phase WBA development process are found in other development process models. For example, rapid prototyping, like that of Phase 1, is a common means of analyzing requirements and reducing errors [Gomma 1990]. It can be found in several landmark models, like the Spiral Model [Boehm 1988], the Throwaway Prototyping model and the Rapid Application Development (RAD) model [Martin 1991].

Another common concept is incremental development. Phase 1 supports incremental development by encouraging multiple iterations of the development cycle, each focusing on the addition of a few features or components. Experience has shown that incremental development can help solidify the requirements of an emerging system, particularly when the scope or functionality of that system is changing due to shifting user paradigms and evolving business processes [Davis 1988]. However, the consequence of using incremental development as the sole process model is that, eventually, the software system outgrows its original infrastructure and needs to be completely re-engineered [Webster 1995]. Phase 2 of our model provides an opportunity for developers to rethink the system's infrastructure and develop a long-term, maintainable architecture, at just the point when users have had a chance to digest the possibilities and benefits of a WBA and before they have locked into a long-term solution.

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[1] Readers interested in this site can find it at http://www.byways.org/grants2. We recommend that readers who wish to test the site do so on our development site, http://ubn.cs.usu.edu:8080/grants2. The sites are functionally identical, but are on different machines and use different databases. The scenic byways community will appreciate the courtesy.

6 Summary

The two-phase process described in this paper successfully addresses the challenges of web-based application development. The first phase plays a key role in helping the development team understand the requirements and adapt to frequent changes. It also helps all stakeholders grasp the potential of this new medium and assist with unleashing its full potential. The second phase builds on the knowledge gained from the first phase and produces a product that has a better user interface, and is more extensible and maintainable. Both phases are as lightweight as possible without compromising a manager's ability to plan a project and evaluate its progress.

A key aspect of this process is that it works well even when the involved parties are geographically separate. Such far-flung teams have become commonplace with web-based application development.

The experience presented in this paper provides evidence that this two-phase process can work. We plan to apply the same process to additional projects in the coming year. We expect that these projects will share the same challenges as the NSB grant application project.

7 References

[Boehm 1988] Boehm, B.W. (1988). A Spiral Model of Software Development and Enhancement. *Computer*, 21 (5), 61-72.

[Booch et al. 1999] Booch, G., Rumbaugh, J. & Jacobson, I. (1999). *The Unified Modeling Language User Guide*. Reading, MA: Addison-Wesley Publishing Company.

[Davis et al. 1988] Davis, A.M., Bersoff, E.H., & Comer, E.R. (1988). A Strategy for Comparing Alternative Software Development Life Cycle Models. *IEEE Transactions on Software Engineering*, 14 (10), 1453-1461.

[Embley et al. 1992] Embley, D.W., Kurtz, B.D., & Woodfield, S.N. (1992). *Object-Oriented Systems Analysis: A Model-Driven Approach*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

[Gomma 1997] Gomma, H. (1997). The Impact of Prototyping on Software Systems Engineering. *Software Requirements Engineering*, R.H. Thayer and M. Dorfman, eds., 431-440. Los Alamitos, CA: IEEE Computer Society Press

[Martin 1991] Martin, J. (1991). *Rapid Application Development*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

[Paulk et al. 1993] Paulk M.C., Curtis, B., Chrissis, M.B., & Weber, C.V. (1993). Capability Maturity Model for Software, version 1.1. *IEEE Software*, 10 (5), 18-27

[Webster-1995] Webster, B.F. (1995). *Pitfalls of Object-oriented Development*. New York, NY: M&T Books, A Division of MIS:Press, Inc.

Distance Education: Early Lessons Learned

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Abstract: Distance education has become an integral aspect of higher education in recent years. This expansion of institutions of higher education into the foray of a digital learning environment has offered opportunities to the institutions to not only increase the size of their student body, but also offered opportunities concerning the digital learning environment and the impact distance has upon such environments.

The impetus that has led higher education institutions towards the development and introduction of digital distance education into their array of course offerings have not gone unnoticed in recent years. The availability of higher education course offerings through digital distance education would not only offer the ability of a wider range of persons to obtain further educational situations that would not have otherwise been available, offer numerous higher education institutions the ability to branch out into different parts of not only the country but of the world, and to develop courses that would be free of restrictions pertaining to the obtainment of physical space in which to meet, which has become a serious consideration in recent years for all institutions of higher education.

These issues are positive manifestations of real-world concerns that lead to lofty theoretical and philosophical goals within higher education institutions and have the possibility to considerably alter the world of higher education, as we know it today. Yet lessons learned through out the distinct areas of design, development, evaluation and implementation processes have led to careful consideration, reflection, discussion and understanding of distance education and the early lessons learned within such a process.

The lessons learned through such a new, innovative arena have left numerous other designers and developers feeling alone, misunderstood, and without hope of realizing the dream of distance education; however, through the trials and tribulations of the author, along with fellow faculty within the Instructional Technology specialization area at the University of Houston – Clear Lake, numerous early lessons learned are apparent and will aid future designers and developers in their quest for a strong distance education course or program. Early lessons learned within the arena of distance education are worthy of discussion and will lead to a greater understanding of the conceptual, theoretical, subject matter, design, and development issues that are apparent to the distance education coursework designers and developers.

Conceptual Issues

The conceptual issues pertaining to the overall view of exactly what is distance education as defined by the designers and developers of the digital distance education coursework is a serious consideration. Each of the persons who are in place to develop the distance education course must delineate their conceptual understandings of the situation and, after numerous discussions and reflections upon issues of concern, come together to provide an overall concept of exactly what they are trying to accomplish. Only through this initial phase will all the persons involved in the distance education course be able to conceptualize the overall plan, formation and aesthetic values that are impacting the final product. The concept is of utmost importance and, secondly, theoretical issues surrounding the design, development and implementation of the distance education course is a primary concern.

Theoretical Issues

Theoretical issues perhaps more commonly referred to as epistemological underpinnings, drive a course. Three aspects of theory must meld in order to develop a successful course: the instructor's theoretical belief structure; each individual developer's theoretical belief structure; and, the group's theoretical belief structure. Although each individual developing a course will have significant differences in their personal theoretical beliefs, the important aspects are the differences through which problems may arise. The persons developing a course must become aware of differing theoretical viewpoints, become comfortable with other's theoretical viewpoints, calmly and logically discuss theoretical issues that may arise through out the design and development of the distance education course, and agree to respect each other's differing theoretical views. Without such an undertaking at the beginning of course development, issues and misunderstandings may arise because theoretical viewpoints were not clearly delineated, discussed and decided upon at the beginning of the design and development period. Although this task may take a significant amount of time and reflection on the part of the design and development team, perhaps up to a few months of what may be considered as "lost" time, it will aid in the clarity of purpose and understanding that will occur at a later time in the group process.

A question that may arise is whether an individual, who has decided to take upon himself or herself the process of designing and developing a course, must work through their own personal theoretical issues before beginning the design and development of the course. The answer, most simply, is: yes. It is most useful for anyone who engages in this process to clearly articulate their own theoretical beliefs and understandings so that an understanding of "why" something is chosen or "what" should be included can be rationalized. Without such an understanding, diligent effort through out the design and developmental periods may be more of an emotional reaction rather than a clearly defined and articulated plan. Once the theoretical issues are worked through, the subject matter issues begin to arise.

Subject Matter Issues

Subject matter is always an issue when developing a course. How much to include, when to include it, within what framework should the subject matter be introduced to the student, what type of learner assignments and evaluative methods should be introduced to obtain the highest level of understanding? An even more difficult question that the subject matter expert must address is whether the course should be offered as an online course, rather than a face-to-face course. Theoretical coursework may be offered as online coursework in a successful manner but what about hands-on, production type of courses? Should these be offered online, as well? What would be the considerations surrounding an online course for an introductory technology course in which basic technological understandings are introduced to the learner? Would this be a course that would be successful in an online environment? Such thoughts race through the subject matter expert's mind while considering the course content. Numerous issues must be addressed through out the subject matter planning stage that

Design Issues

The design issues surrounding online distance education courses are numerous. After all, the design of a face-to-face course and the design of a digitally transferred distance education course are completely different. The instructor's ability to react to students' nonverbal cues in a face-to-face situation may be useless in an online environment; the instructor's wit and charm in a face-to-face environment may be perceived as tacky and rude in an online situation. Questions and concerns such as these surround the design of the coursework. How will the instructor manage such different environments, especially since online distance education courses are environments in which the instructor may not be familiar and/or comfortable? These are difficult issues. Further, such issues as motivation, the development of an online community, and there is not yet a mention of the obvious question surrounding knowledge attainment, are clearly apparent through out the design process. If such issues are not addressed, there may be a significant opportunity for the course to not successfully meet expectations. Perhaps the design issues for each course are the most thoughtful and time-consuming phase of the whole course initiative.

Development Issues

Once the theoretical, subject matter and design issues have been worked out to a satisfactory end, the development of the distance education course becomes a central theme. If funding is available to have more than one person developing a distance education course, persons available to address each of the following roles would be useful:

- Videographer
- Graphic Artist
- Programmer
- HTML Developer
- Subject Matter Expert
- Instructional Designer
- Instructional Developer (not necessarily the same person as the HTML Developer)
- Audio Developer

Although this is an exemplary situation in which very few persons find themselves, it may be more efficient to have at least one person focusing upon their own specific duties.

Unless the subject matter expert is significantly skilled within the areas of instructional design and instructional development, it may be best to leave such considerations to an expert in the respective areas. Perhaps the most difficult aspect of the team process is allowing the group members the opportunity to realize that they may not be the best choice to address more than one specific role. For example, the subject matter expert may be of the opinion that, since they know the knowledge, they are also the most appropriate person to act as instructional designer and instructional developer; although this may be true for some persons, it may not be true for all and herein lies the difficulty. Clearly articulated roles within a group environment must be defined at the outset so that problems do not arise during the design and development phases. Emotions and ownership will become issues during the design and development of the distance education course and the role assignments of each team member will be an additional impediment that could seriously sidetrack the course development and cause hard feelings within working relationships.

Evaluation Issues

Formative and summative evaluations of the developing online distance education course are of utmost importance to the development timeline. Numerous areas will be important to address through out the developmental process and the most efficient way of gauging the development of these significant areas is through evaluations.

Formative evaluations are, most simply, evaluations that take place through out the developmental process; these formative evaluations aid in the possible redesign and/or redevelopment of the course. Areas that may be necessary to address during formative evaluations are:

- Navigation Issues
- Interactivities
- Flow of Information
- Knowledge Attainment
- Assignments
- Interface Issues
- Course Structure
- Video Integration
- Graphic Understanding/Compatibility
- Meeting ADA Standards

Although this list is merely a few of the numerous areas that will be addressed during formative evaluations, such evaluations will aid in the development of a superior course.

Summative evaluations, most simply, are evaluations that occur at the end of the developmental period in order to evaluate the final product. Such evaluations, when implemented after numerous formative evaluations, are positive in nature.

Implementation Issues

Once the developmental period is complete and summative evaluations have been obtained, it is time to implement the online distance education course. Initial implementation of the distance education course may be best as a pilot project, in which several students work through the course to offer feedback on areas of success and areas that may require further thought. The pilot of the course can easily be implemented during a normal semester time period in which the students not only may take the online course as course credit, but may also act as reviewers and offer feedback on different aspects of the course. After the formative and summative evaluation periods, the implementation of the course should be successful with only a few points of further development being of significance.

Conclusions

The design and development of a digital distance education course offers several topic areas through which to navigate. The careful consideration, reflection, discussion and understanding that is not only apparent but also clearly a mandatory undertaking to the design and development of a successful distance education course are of utmost importance. Each aspect of the design and development is of primary concern and will offer numerous benefits once the sober realization that this type of development can not possibly transpire through one person's determination occurs. The professional working relationship of a group of persons will result in a successful, superior product that will offer learners a positive environment through which to obtain knowledge, successfully integrate this knowledge into a prior knowledge base, develop quality assignments and the comfortable evolution of an online community.

Computer-Supported Distance Art Therapy: Beyond Computerization

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Abstract: In the recent years, distance mental health services using the Internet have become increasingly common. However, this expansion has occurred in the absence of research about the effectiveness, safety, and legality of such services. This paper presents a study in which we have actively involved mental health practitioners in the development and evaluation of the system for computer-supported distance art therapy that we have created, and discusses some of the broader issues that emerged that might be of relevance to the development of groupware systems.

1. Introduction

Recent developments in the computer industry and telecommunication infrastructure have given rise to *telehealth*, health care delivered from a distance. In the United States, the federal Medicare agency is promoting telehealth — with funding through the Federal Communications Commission — and several states have passed legislation mandating third-party payment for both physical and mental health services provided by means of videoconferencing or Internet [Sleek 1997].

With the emergence of telehealth there has been a rapid expansion of distance mental health services. There are already hundreds of text-based counselling and therapy sites on the Internet [see Marson 1997; Sampson, Kolodinsky & Greeno 1997], and telepsychology and telepsychiatry networks employing videoconferencing technology are being established throughout North America. This expansion has occurred in the absence of research about the effectiveness, safety, and legality of distance mental health care [see King, Engi & Poulos 1998; Preston, Brown & Hartley 1992; and Robson & Robson 1998].

Mental health professionals are being called upon to be involved in the development as well as the assessment of telehealth systems, by collaborating with computer scientists in human-computer interaction (HCI) and computer-mediated communication (CMC) on the development of telecommunications systems specifically for telehealth [Lee 1998; Sanders & Rosenfield 1998] — rather than relying on computer communication systems designed for corporate communication or leaving the design of telehealth systems in the hands of the telecommunications companies that are pushing the telehealth movement forward.

The study we discuss in this paper directly addressed the need for research about distance mental health care and the need for active involvement in the development of telehealth systems on the part of mental health clinicians. We used participatory design to develop and evaluate an innovative computer system for distance therapy. One of the authors (KC) is a graduate student in Counselling Psychology who is also a professional artist. The other two are a graduate student (DC) and a faculty member (KB) in Computer Science who are working in human-computer interaction (HCI) and computer graphics. The computer system is designed to address the needs of people with mobility limitations, such as people with disabilities or long-term illnesses, but has application for online art therapy or creativity training with a variety of populations.

In the remainder of this paper, we give the background information on art therapy and the state of telehealth today, briefly describe the development and evaluation of the system for computer-supported distance art therapy that we have created, and discuss some of the broader issues that emerged that might be of relevance to the development of groupware systems.

2. Art Therapy and Telehealth

Telehealth has the potential to make health care more available to people who in the past have been underserved, such as the elderly, people in remote or rural areas, people outside the cultural mainstream, people in lower socio-economic groups, and people with illnesses or disabilities [Brauer 1992; Sampson, Kolodinsky & Greeno 1997]. Telehealth shows particular promise for people who have disabilities that affect communication, as computers with assistive devices can facilitate basic communication as well as making it possible to span geographical distances.

While email is currently the most common way to conduct therapy on the Internet, it has a significant drawback that everything said has to be reduced to text as clients and counsellor type on keyboards, and the directness of face-to-face therapeutic encounters is lost. Email is also asynchronous, an even bigger problem. The system for distance art therapy that we have designed allows a much closer approximation of face-to-face session than does email, and does so without the additional expense and network bandwidth required for video conferencing. Our system allows speech communication and the transmission of hand-drawn images. Communication is direct and synchronous: the therapist sees the images created by the client as they are being made, and the client and therapist can speak to each other as if they were using speaker phones. The presence of the art images provides some compensation for the lack of a visual dimension to the therapeutic relationship.

One of the foundations of art therapy is the idea that the creative process is intrinsically therapeutic [Tibbetts 1995]; in art therapy, the client's art becomes a metaphor for the change process, and can be a symbolic arena for creating preferred scenarios --- for bringing what is desired into the realm of possibility [Fryrear & Corbit 1989]. Making art is thought to promote a sense of mastery and control, to improve self-esteem, and to strengthen identity [Brooke 1995; Hagood 1991]. The fact that these therapeutic aspects are somewhat independent of interaction with the art therapist is an additional reason art therapy is suitable for online counselling. Art therapy clients have therapeutic relationship with their art images as well as with their therapists [McNiff 1992], and in distance art therapy, clients are still co-present with their art even though the therapist is somewhere else.

Our primary target population when we began to conceptualize the project was clients isolated by illness or disability, people we thought could benefit from group support as well as therapeutic help from a counsellor. We decided the computer system should support group art therapy for this reason. This decision was made in light of the recognized benefits of group support during recovery from long-term illnesses [Fawzy et al. 1994], and the growing popularity of Internet support groups for people with medical difficulties [Weinberg et al. 1996].

3. System Development and Evaluation

Our system supports a form of group art therapy where participants use networked computers to communicate with each other using speech (in the computer equivalent of a telephone conference) and hand-drawn images that everyone in the group can see and collaborate in drawing.

We used participatory design for the development and evaluation of the computer system. Two themes govern the practical implementation of participatory design principles: *mutual reciprocal learning* and *design by doing* [Floyd et al. 1989]. Thus, structuring the project as a participatory design study well suited its interdisciplinary and exploratory nature.

There were three stages to the participatory design process. The first was an initial collaboration between DC and KC, during which we learned the possibilities and constraints of the other's discipline and began designing the system. When we had a working prototype, we worked with groups of graduate student volunteers to refine the system and to determine what kinds of communication it could support. In the final stage, the evaluation phase, ten people with expertise or experience relevant to online counselling used the system and participated in a series of group and individual interviews. We emphasized that members of the team would be co-researchers with us, and that their observations were the focus, not our observations of them. Detailed descriptions of the design of the system and the collaborative process have been published elsewhere [Collie, Cubranic & Booth 1998; Cubranic, Collie & Booth 1998]. Work on the system continues, with ongoing projects to port it to Microsoft Windows NetMeeting platform and to provide a Web-based contact point for the therapist and clients.

The purpose of the evaluation was to bring to light issues relevant to the design and implementation of telehealth systems beyond the issues that had already been identified or postulated. The data we collected during the evaluation phase consisted of: transcriptions of group discussions; our own observations; notes taken by various members of the team during the sessions, including notes made by participants while observing art therapy sessions from the point of view of the art therapist; notes made by participants between sessions; and notes made by KC after the group sessions, and during and after the individual interviews. We conducted a content analysis of these data to create a clear picture of the counselling issues that emerged. The main result of the evaluation was a list of considerations regarding the development and implementation of distance mental health services [Collie, Cubranic & Long].

4. The Emergence of Protocols

Many problems or potential problems were discussed during the evaluation, but the co-researchers generally were able to suggest solutions to the problems they identified. These solutions were usually in the form of communication protocols for using the system, that would ensure such things as confidentiality, privacy, autonomy, and a non-judgmental atmosphere --- as well as ease of communication. The content analysis of the evaluation data revealed a fairly comprehensive set of communication protocols that were generated during the study. Some were suggested by the co-researchers as the used the system; others were suggested in retrospect during the round-table discussions. What follows is a list of these protocols that is in two parts: a set of general guidelines for online group communication in a therapy setting, and guidelines that are specific to online group art therapy when people are looking at each other's art works.

General protocols:

- identify yourself by saying your name before you speak
- speak more frequently than you might expect to in order to maintain a sense of connection with the group
- expect pauses and silences during group interactions
- provide information about your surroundings as you talk with the group
- let the group know if anyone is present with you
- provide information about how you are feeling and what is going on for you

Guidelines for looking at other people's art works:

- only look with permission to look
- say that you are looking
- use *active looking* (i.e., have your pointer present and activated in the image you are looking at, use it to track you gaze, and point to the parts of an image you are talking about)

When working with computers, it is easy for the equipment to become a focus of attention, and for the distinction between the computer system and the information it carries to get lost [Kling 1995]. The fact that protocols for online communication were an important theme in the research team's discussions suggests that, when developing online counselling services, the focus needs to be on the communication as much as on the system that is the vehicle for the communication. In describing how *communication work* is crucial to the success of computer-networked design teams, Robertson [1997] makes the point that this work, and the skills of communication, relationship building, and coordination, are often overlooked. She suggests the reason that this aspect of computer-supported collaborative work is often de-emphasized is that these skills have traditionally been women's skill. Robertson is an advocate for ``making communication work more visible within the discourses of technology design", and for designing systems that are flexible enough to ``accommodate the highly specific ways that language is used to accomplish ... communication work".

The results of our study corroborate Robertson's perspective. The discussions sometimes centred on the pros and cons of the computer system and on specific human-computer interaction issues, but they tended to gravitate back to issues of human communication. It has already been noted that people adapt to the communication channel available [Vera et al. 1998] --- we feel that with the human dimension of the system being the dimension with the most flexibility, it is no wonder that is what the co-researchers talked about the most. This flexibility is all too often disregarded in favour of a technological cure-for-all; if systems and procedures were developed together, then there would be more potential to take advantage of this untapped resource.

5. Conclusion

When developing a new kind of system like this, it is not just the computer system that is being developed, but also the procedures for using it. The two go hand-in-hand and are developed in an iterative process with feedback going both ways: Just as the capabilities of the system influence the development of methods of communication, so do the new requirements of those methods influence further system development. If these two aspects of a new system are developed in parallel with attention being given to both, then the quantum leap long-promised by CSCW might come significantly closer to realization. Attention also needs to be paid to how the procedures are going to be taught to the users of the system. Technical manual exists for learning the *mechanics* of using new software, but training and practice are required to learn new communication modalities afforded by it. It is easy to get caught up in the development of a groupware system itself (and what it can and cannot support) and fail to pay adequate attention to the difficult process of creating the new methods of communication to use with the system. Perhaps this is yet another, more subtle reason, why groupware applications may fail [Grudin 1989].

6. References

[Brauer 1992] Brauer, G. W. (1992). Telehealth: The delayed revolution in health care. *Medical Progress Through Technology*, 18, 151–163.

[Brooke 1995] Brooke, S. L. (1995). Art therapy: An approach to working with sexual abuse survivors. *Arts in Psychotherapy*, 22, 447–466.

[Collie, Cubranic & Booth 1998] Collie, K., Cubranic, D., & Booth, K. S. (1998). Participatory design of a system for computer-supported distance art therapy. *Proceedings of Participatory Design Conference 1998*, Seattle, WA.

[Collie, Cubranic & Long] Collie, K. R., Cubranic, D., & Long, B. (in progress). Art therapy on-line: A participatory action study of distance counselling issues.

[Cubranic, Collie & Booth 1998] Cubranic, D., Collie, K., & Booth, K.S. (1998). Computer support for distance art therapy. *Summary of CHI '98*, ACM Press, Los Angeles, CA. 277–278.

[Fawzy et al. 1994] Fawzy, F.I., Fawzy, N. W., Hyun, C. S., Elashoff, R., Guthrie D., Fahey, J. L., & Morton, D. L. (1994). Malignant melanoma: Effects of an early structured psychiatric intervention, coping, and affective state on recurrence and survival 6 years later. *Archives of General Psychiatry*, 50, 681–689.

[Floyd et al. 1989] Floyd, C., Mehl, W.-M., Reisen, F.-M., Schmidt, G., & Wolf, G. (1989). Out of Scandinavia: Alternative approaches to software design and system development. *Human-Computer Interaction*, 4(4), 253–350.

[Fryrear & Corbit 1989] Fryrear, J. L., & Corbit, I. E. (1989). Visual transitions: Metaphors for change. In *Advances in Art Therapy*, New York, NY: John Wiley & Sons. 275–295.

[Grudin 1989] Grudin, J. (1989). Why groupware applications fail: Problems in design and evaluation. *Office: Technology and People*, 4, 245–264.

[Hagood 1991] Hagood, M. M. (1991). Group art therapy with mothers of sexually abused children. *Arts in Psychotherapy*, 18, 17–27.

[King, Engi & Poulos 1998] King, S. A., Engi, S., & Poulos, S. T. (1998). Using the Internet to assist family therapy. *British Journal of Guidance and Counselling*, 26(1), 43–52.

[Kling 1995] Kling, R. (1995). Controversies about computerization and the organization of white collar work. *Human-computer Interaction: Toward the Year 2000*. Baecker, R., Grudin, J., Buxton, W. A. S, & Greenberg, S., eds. San Francisco, CA: Morgan Kaufmann. 254–272.

[Lee 1998] Lee, C. (1998). Counselling and the challenges of cyberspace. *Counseling Today*, 5.

[Marson 1997] Marson, S. M. (1997). A selective history of Internet technology and social work. *Computers in Human Services*, 14(2), 35–49.

[McNiff 1992] McNiff, S. (1992). *Art as medicine: Creating a therapy of the imagination*. Boston, MA: Shambhala.

[Preston, Brown & Hartley 1992] Preston, J., Brown, F., & Hartley, B. (1992). Using telemedicine to improve health care in distant areas. *Hospital and Community Psychiatry*, 43(1), 25–32.

[Robertson 1997] Robertson, T. (1997). "And it's a generalisation. But no, it's not": Women, communication work, and the discourses of technology, design. *In Proceedings of the 6th International IFIP Conference on Women, Work, and Computerization*, Hamburg, Germany. 263–275.

[Robson & Robson 1998] Robson, D., & Robson, M. (1998). Intimacy and computer communication. *British Journal of Guidance and Counselling*, 26(1), 33–41.

[Sampson, Kolodinsky & Greeno 1997] Sampson, J. P., Kolodinsky, R. W., & Greeno, B. P. (1997). Counseling on the information highway: Future possibilities and potential problems. *Journal of Counseling and Development*, 75(3), 203–212.

[Sanders & Rosenfield 1998] Sanders, P. & Rosenfield, M. (1998). Counselling at a distance: Challenges and new initiatives. *British Journal of Guidance and Counselling*, 26(1), 5–10.

[Sleek 1997] Sleek, S. (1997). Providing therapy from a distance. *American Psychological Association Monitor*, August 1997. Available online at APA World Wide Web site at http://www.apa.org/monitor/aug97/video.html.

[Tibbetts 1995] Tibbetts, T. J. (1995). Art therapy at the crossroads: Arts *and* science. *Art Therapy*, 12(4), 257–258.

[Vera et al. 1998] Vera, A. H., Kvan, T., West, R. L., & Lai, S. (1998). Expertise, collaboration, and bandwidth. *Proceedings of CHI 98*, Los Angeles, CA. 503–510.

[Weinberg et al. 1996] Weinberg, N., Schmale, J., Uken, J., & Wessel, K. (1996). On-line help: Cancer patients participate in a computer-mediated support group. *Health and Social Work*, 21(1), 24–29.

Why to use a dynamic adaptive hypermedia for teaching, and how to design it?

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Abstract : For many years, hypermedia has been a new research area in the field of computer aided teaching systems. Three kinds of systems have successively appeared: first classical hypermedia, then adaptive hypermedia and finally dynamic adaptive hypermedia. Dynamic adaptive hypermedia systems are more efficient, but they are rarely multimedia and hardly ever use the Internet to send courses. This paper begins with a historical reminder then introduces the architecture of METADYNE, a dynamic adaptive hypermedia system. This system allows to create and to distribute multimedia-based courses adapted to the learner, and to transmit courses via the Internet. An open architecture and the respect of standards allow the user to connect to the system with a simple browser, and enable the system to connect a large range of pedagogical multimedia databases.

1. Introduction.

Further ITS (Intelligent Tutoring System) [Baron 95] and ILE (Intelligent or Interactive Learning Environment) [Dillenbourg 93] researches on Computer Aided Teaching have taken an interest in hypertext system. However the main advantage of those hypertext systems, i.e. the liberty of navigation, has quickly become a major inconvenient for many systems (for instance information systems, help systems, research systems, etc.) and especially teaching systems. Therefore, researches have tried to lead the student according to his knowledge, by changing the content of pages and links between pages: adaptive hypermedia was born. But afterwards, other studies have shown that those systems were not perfect. So there is now a third kind of hypermedia system: dynamic adaptive hypermedia system, i.e. systems which build, in a dynamic way, the pages and the links of the hypermedia according to the student's characteristic. The aim of the METADYNE project is to design a dynamic adaptive hypermedia system, which is really multimedia and uses Internet to send the courses.

First we are going to study the advantages and disadvantages of the different kinds of hypermedia systems. Then, we are going to introduce the architecture of our system. To conclude, we will introduce the perspective of our work.

2. The hypermedia systems for teaching.

In this section, we are going to introduce the three kinds of hypermedia systems, defining their characteristics and analyzing their advantages and their disadvantages in an educational use.

2.1. What is a hypermedia system?

The word *hypermedia* is the concatenation of two words : *hypertext* and *multimedia*. A hypertext system is a system that allows somebody to introduce different information in a non-linear way. Hypertext is constituted of nodes and links. The nodes, or the pages, of the hypertext are made up of textual information, and the links allow the user to activate other pages. Hypermedia stands out from hypertext by the contents of the nodes. Nodes are not only made up of textual data, but they are also made up of multimedia data, like pictures, sounds, videos or interactive applications. Therefore, some authors use *hypermedia* or *hypertext* words indifferently to show that the main interest of those systems is not the content but the architecture.

2.1.1. Why to use a hypermedia system for teaching?

In fact, there are two points that encourage authors to use hypermedia for teaching. These two points are the consequences of the architecture of the hypermedia system, i.e. multimedia and hypertext aspects.

First, different researchers tried to estimate the interest of multimedia system for teaching. Then [Hoogeveen 95] emphasised some criterions, like "Level of Multimediality", "Level of Man-machine Interactivity" and "Level of Congruence" that allow us to estimate the teaching quality of this kind of system. While reading this paper, we conclude that multimedia increases the educational quality of teaching system because visual and play aspects are more attractive for students.

Second, hypertext component can perform educational quality of teaching hypermedia, because the architecture of those systems allows the student to structure his knowledge, to understand better the ins and outs of each concept of knowledge. By the non-linearity of his progression, he has to build his knowledge by creating links between each concept. Indeed, like J.F. Nadeau wrote in [Nadeau]:

> *Learning like thought can not be structured with isolated ideas but with significant or associative links between ideas [...] The hypermedia system becomes a tool to structure the thought.*

2.1.2. Why not to use a hypermedia system for teaching?

Those two advantages can become disadvantages, since they are able to disorientate the student, as they introduce too much media to the student we call it: *cognitive surfeit* [Rhéaume 93].

First, the disorientation is the consequence of the opportunity for the student to move in the structures of the system. This freedom risks finishing to cloud him, and the student may wonder some question like "Where am I?", "Why am I here?" or "Why must I do?". Rhéaume explains that this is the result of our short-term memory, since as Miller proved it in [Miller 56], human-being are only able to memorize in one moment little information, about seven topics.

Second, cognitive surfeit is the result of the avalanche of information that the system risks sending to the user. Indeed, the redundancy, to be good, must be built in an intelligent way. For instance, the same information must not be introduced to the student with different media which need different levels of knowledge.

2.2. What is an adaptive hypermedia system?

Researchers have tried to minimize negative points of hypermedia for teaching by making adaptive hypermedia. The main goal of this kind of system is to adapt the way to introduce knowledge to the student and to lead the student in the hyperspace[1]. Therefore, in this kind of hypermedia, the system can modify the content of pages and the links between them [Brusilovsky 96]. In order to lead the student, different techniques have been created [Brusilovsky 98]. We can find for instance techniques of direct guidance, adaptive ordering, adaptive hiding or adaptive annotation.

The architecture of adaptive hypermedia systems as in many teaching systems, is mainly based on two models: the domain model and the student model. The domain model represents the knowledge in a rough way, the student model represents student's knowledge.

There were three generations of adaptive hypermedia system. The first one used the *index page method*, where each concept is connected to a page. Through this page, the user can reach all other pages dealing with this concept. The next generation of systems used an index page again, but those index pages allowed to reach significant fragments of pages. It was called *fragment indexing method*. This technique is similar to the first one, but leads to a more accurate index. The latest generation of adaptive hypermedia systems has based the hyperspace on the domain model structure [Vassileva 97]. Each concept is linked to one or few pages and the relations are represented by hypertext links.

2.2.1. Why use an adaptive hypermedia system for teaching?

Adaptive hypermedia system is better than a classical one because techniques that are used allow the student to be guided without deleting his free navigation, and allow the teachers to structure better their knowledge (mainly in the last generation of hypermedia). Indeed the fact to distinguish the knowledge from the media that will be used to introduce them allows the teachers to structure better their jobs. For that they first organize the knowledge and they think how to introduce it.

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[1] The hyperspace is the graph that forms by the page and the links of the hypermedia system

2.2.2. Why not to use an adaptive hypermedia system for teaching?

However, there are some issues left. First researchers were interested mainly in how to lead the student in the hyperspace, but not in how to perform the content of pages that are introduced to the student. We can explain this established fact because researchers experienced their new technologies on existing hypermedia systems. And it is easier to hide or to annotate links than to replace the element of pages by others. Second, as the courses are not adaptable, in some cases the structure of these courses may change, and therefore disorientate the learner.

2.3. Dynamic adaptive hypermedia for teaching.

As a consequence of the two disadvantages of adaptive hypermedia, dynamic adaptive hypermedia appeared. The main characteristic of this kind of system is to propose to the user a virtual hypermedia [Vassileva 95]. Such systems are not implemented with physical pages: these ones are dynamically built. The architecture of these systems is based on four components: the domain model, the student model, a teaching materials database and a courses generator [Vassileva 92]. The domain model, like the latest generation of adaptive hypermedia, allows to determinate the hypermedia structure. There are therefore two bijections:

- between knowledge concept of domain model and hypermedia pages,
- between relations between those concepts and links between hypermedia pages.

2.4. Conclusion.

During the fifteen last years, researches about hypermedia teaching system have continuously performed different techniques. First, researchers used classical hypermedia system, then they created adaptive hypermedia system and now the focus is on dynamic adaptive hypermedia system.
However, dynamic adaptive hypermedia systems are often dynamic adaptive hypertext systems, but rarely multimedia. Moreover those systems are often private, they are not distributed, they do not use the Internet network.
The goal of our system, called METADYNE, is to be a real dynamic adaptive hypermedia, by taking into account all the characteristics of the user. The adaptation must be effective as many links as content of pages, by using multimedia data to build courses and by using Internet network to distribute them.

3. METADYNE.

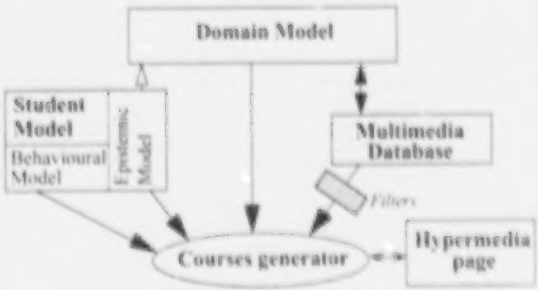

Figure 1 - Architecture of Metadyne

METADYNE is a system of design and distribution of courses via Internet network. In addition to intrinsic characteristics of dynamic adaptive hypermedia systems, it must:

- propose uniform and really multimedia courses,
- take into account the knowledge level of the student as well as his tastes or his goals,
- offer tools allowing to represent the knowledge of a group of teachers, allowing them to put their knowledge in common and allowing the system to perform its adaptation.

As we can see in the figure 1, the architecture of our system is based on four classical components: the domain model, the student model, multimedia database and the courses generator.

In this section, we study these four components, by putting original things forward that will allow us to reach fixed goals. To perform this presentation, we use some examples, from a course about RLC electric circuits. We have made this choice, because we can use a lot of multimedia to introduce RLC electric circuits, for instance textual data for definition or demonstration, picture for electric assembly diagram or vector representation, video to explain how to make electric circuits and simulation software to manipulate virtual electric circuits. Moreover, this course requires many prerequisite, mainly in mathematics and physics, and allows the student to choose different tools to resolve some issues.

3.1. The domain model.

It defines the structure of the hypermedia system. We use a semantic network to represent it. There is an appropriateness between the couple concept-relations of the semantic network and the couple page-links of the hypermedia system. The concepts of this network are linked together with four kinds of relation:

- *is sequentially composed by*, enables to brake up the teaching of a concept into the teaching of a succession of concepts. For instance, a course about derivates can begin with a course about simple formulae, then a course about calculation of derivate functions, and finally a course about slopes of tangent.
- *is derivated in*, enables to show a concept through different points of view. For instance, a course about the light can be a course about corpuscular theory or about ondulatory theory.
- *needs the knowledge of*, enables to select what has to be known to understand the concept. For instance, courses about derivates and limits are prerequisites of a course on asymptotes.
- *is able to be helped by the knowledge*, allows to urge the student to go and see one concept as well as to initialize user model on the current concept. For instance, having the knowledge of the Pascal language can be considered as an advantage while learning the C language.

The two last relations are weighted. These weights allow the system to lead better the student in the hypermedia system. For instance the system considers that a student needs to revise a prerequisite if his mark is lower than the weight coefficient of the link.

Finally, we consider that it is important to provide to the teachers a way to put their knowledge in common, allowing each one to preserve his own vision of the model. Therefore, with this model, we want each teacher to be able to access to the different points of view about the model (i.e. the point of view for a given teacher, the point of view of a group of teachers and of all the teachers). So each concept, each relation and each weight coefficient are labeled. This kind of annotation has two main advantages. First, each teacher can estimate his vision of a domain model according to his colleagues' vision. The second advantage concerns the student: the system can choose different pedagogical strategies. For instance, if the student wants to consult a course for an exam, the system will mainly use the point of view of the teacher that will give him a mark. On the other hand, if the student freely uses the system, then the system will let him have a larger vision on the subject.

3.2. The student model.

Besides the domain model, a good representation of student model is essential. As researches about user model is a full filed of artificial intelligence, our aim is not to perform existing model. So we decided to use a model introduced in [Nicaud 94] and [Balacheff 92]. This model is made up of two sub-models: an epistemic model, and a behavioural model.

3.2.1. The epistemic model.

This model allows the system to know what the learner is supposed to know or not to know. As this knowledge is closed from the knowledge represented by the domain model, the epistemic model can be regarded as a derivative of it. Then each concept of the domain model is linked with the epistemic model of the learner by a weighted relation. Until now, teaching systems use three kinds of weights [Brusilovsky 96b]. There are binary weights (the learner knows or does not know the concept), discrete weights, by defining different categories (for instance, novice, middle, expert), and continuous weight (values are chosen between two extremes values). It is this last technique we decided to use because we think it is the most efficient one. Moreover, it is the only one that allows the system to take time intp account an easy way, and time is a parameter that we decided to use (the idea came from mnesic network of [Jorion 89]). Indeed, to perform our epistemic model, time is considered as a variable of forgetting, because everybody who does not revise regularly a knowledge, may forget them partially or totally. Finally, the system does not confuse its ignorance and learner's ignorance.

To resume, our epistemic model exists by relations that are built between itself and the domain model. These relations are weighted with a value. They underscore what the system knows about the learner's knowledge about one concept. This value is either "I ignore the state of the learner's knowledge" or "I know the state of the learner's knowledge" and in this case a real value is associated, proportional to the level of the learner's knowledge, and updated according to the date of the last rereading of the concept.

3.2.2. The behavioural model.

Whereas the epistemic model is always used in teaching system, the used of behavioural model is often limited or lacking. Our adaptive system wants to be as near as possible the student, i.e. the system must take into account his preferences, his aims and his intellectual abilities.

- The student's preferences will have an impact on the organization of course pages. Indeed, while the student profile is initialized, student will set all the characteristics of what we call the 'canvas'. This canvas will be used as a model to define the structure of all the courses that will be introduced to the student.
- The student's goals will have an impact on the system behaviour. Indeed, as the student wants to revise for an exam or not, the system will have to be more or less flexible.
- The student's ability will be taken into account, not in a global way, but in changing the model according to the teaching subject. Then, depending on the subject, the system will suppose or require a specific level knowledge for the student, and in the same way the temporal weights of the epistemic model will change according to the subject.

To finish, let us notice that those two sub-models are intimately linked. For instance in the epistemic model, the temporal variation of weights is according to the behavioural model.

3.3. The multimedia database.

The third component of our system is the multimedia database allowing the system to introduce every concept. This database is made up of "elementary brick". Each brick is associated with one concept of the domain model. They are characterised by three attributes : the cognitive type, the cognitive level and the physical type.

- The cognitive type allows the system to sort media according to their teaching nature (for instance an introduction, a definition, an exercise, an abstract, etc…). That allows to get hypermedia pages that follow the structure of the canvas.
- The cognitive level allows the system to associate a media with a knowledge level that is required for a good understanding of the information introduced.
- The physical type allows the system to specify the multimedia quality of each media (text, picture, video, interactive application, etc…). This attribute allows once again the system, when it built a hypermedia page, to follow instructions defined in the behavioural model.

Moreover, [Recker 95] proposes to associate in an intelligent way physical and cognitive types. For instance, it is preferable to use textual media to introduce examples, annotations or definitions. But it is preferable to use sound media to introduce abstract or to warn the user.

To finish, this database will be able to be local, away or distributed. That allows the teachers to use his elementary bricks or to use elementary bricks that will be placed in another server, for instance SEMUSDI [Delestre, Rumpler 98].

3.4. The courses generator.

This last component builds the pages that will be introduced to the student. Its job is to:

- As soon as the student has chosen the course that he wants to follow (in our case the course about Force damped oscillator), the system selects the good concept in the domain model.
- Then, the system takes the canvas of the student (from the behavioural model) and gets his knowledge about the chosen concept (from the epistemic model).
- Then, the system chooses the various media to introduce the concept according to the structure of the canvas, and the student's preferences (from the behavioural model). This selection is the result of the use of three fil-

ters. The first one sorts the elementary bricks according to their cognitive type, the second one according to their cognitive level and the last one according to their physical type. If the selection does not allow the system to choose an elementary brick, the system can deactivate the filters and begins by the last one.

- Then, the system determines the relations according to the domain model, the student's knowledge (epistemic model) and the student's goals (behavioural model). For instance, in our case, for the demonstration about the calculation of phase difference between the intensity and the voltage, the system will be able to activate two different prerequisite relations (either on mathematical concept of Fresnel construction or on mathematical concept about complex number).
- To finish, the system builds the hypermedia page (HTML page) and sends it to the student.

The student actions (for instance when he clicks on link or when he resolves exercise) allow the system to update the current student model and to propose another page.

4. Conclusions and perspectives.

Dynamic adaptive hypermedia systems are a real new way of researches compared with the other computer aided teaching system. Although the architecture of our system looks like the architecture of some another system, it stands out by:

- the use of filters to choose the media that allows to introduce the knowledge with the better way,
- the standardization of course structure thanks to the use of canvas,
- our will that the adaptive system takes into account not only the student knowledge, but the student preferences and goals too (the system is not only an adaptive system, it is an adaptable system too),
- our will to offer to the teacher a tool which allows them to put their knowledge in common.

Until now, we have mainly worked on the SEMUSDI Server, on the global design and on the object design of METADYNE. Now, we work to resolve technical issues, and mainly on communication between the client and the server (between JAVA applet and the server). We have the opportunity to test our system with the student of the INSA of Rouen.

5. References.

[Balacheff 92] Balacheff N. (1992), Exigences épistémologiques des recherches en EIAO, *Génie Educatif* (4).

[Baron 95] Baron M. (1995), EIAO quelques repères, *Revue Terminal.*

[Brusilovsky 96] Brusilovsky P. (1996), *Adaptative Hypermedia : An Attempt and Generalize*, P. Brusilovsky, P. Kommers, N. Streitz (Eds.), Multimedia, Hypermedia, and Virtual Reality (1077) 288-304. Berlin: Springer-Verlag.

[Brusilovsky 98] Brusilovsky P. (1998), *Adaptive Hypertext and hypermedia*, Kluwer Academic Publishers.

[Delestre 97] Delestre N., Gréboval C., Pécuchet J.P. (1997), METADYNE, a Dynamic Adaptive Hypermedia System for Teaching, *3rd ERCIM Workshop User Interfaces for All, 143-149.*

[Delestre, Rumpler 98] Delestre N., Rumpler B. (1998), Architecture d'un Serveur Multimédia pour les Sciences de l'Ingénieur, *NTICF'98, Rouen*, 39-46.

[Dillenbourg 93] Dillenbourg P. (1993), Evolution épistémologique en EIAO, *Ingenierie Educative, Sciences et Techniques Educatives,*(1), 39-52.

[Hoogeven 95] Hoogeven M. (1995), Toward a New Multimedia Paradigm : is Multimedia Assisted Instruction Really Effective ?, *Proceedings of ED-MEDIA 95 World Conference on Educational Multimedia and Hypermedia*, 348-353.

[Jorion 89] Jorion P. (1989) *Principe des Systèmes Intelligents*, Science Cognitive.

[Miller 56] Miller G.A. (1956), The magical number seven plus or minus two: some limits on our capacity for processing information, *Psychological Review*,81-97.

[Nadeau] Nadeau, F. Application et impacts de l'hypermédia constructif sur l'apprentissage, *http://www.fse.ulaval.ca/fac/ten/64448/nado/semi.html.*

[Nicaud 94] Nicaud J.F. (1994), *Modélisation du raisonnement algébrique humain et conception d'environnements informatiques pour l'enseignement de l'algèbre*, Scientific rapport, LRI, Paris XI.

[Recker 95] Recker M. (1995), Cognitive Media Types for Multimedia Information Access, *Journal of Education Multimedia and Hypermedia.*

[Rhéaume 93] Rhéaume J. (1993), Les Hypertextes et les Hypermédias, *Revue EducaTechnologie*, (2).

[Vassileva 95] Vassileva J. (1995), Dynamic Courseware Generation : at the Cross of CAL, ITS and Autoring, *Proceedings of the International Conference on Computers in Education, ICCE'95*, Singapore, 290-297.

[Vassileva 97] Vassileva J. (1997), Dynamic Courseware Generation on the WWW, *Proceedings of the workshop : Adaptive Systems and User Modeling on the World Wide Web, Sixth International Conference on User Modeling.*

Introducing Web Based Training (WBT) to a Web Illiterate Company

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Abstract: WBT was introduced to a web illiterate company over a two-year period. Three regulatory training courses and 17 entry-level technical modules are now delivered over the corporate Intranet. The implementation design, successes and lessons learned are documented.

1. Introduction

The American Society for Training and Development (ASTD) suggests that the number of companies using Intranet or Internet-based training is growing each year. The advantages of WBT are well documented (see Gayeski (1998), Pieterse (1998) or Wilson (1999) for example), and concrete examples of implementation projects are becoming more visible (Cohen (1997), Driscoll (1998), Eline (1997), Wynn (1997). We utilized an action research framework of repeating cycles of planning, acting, observing and reflecting (Stringer, 1996) over a two-year period with a mid-sized company to introduce web based training. Three regulatory training courses and 17 entry-level technical modules are now delivered over the corporate Intranet. Our implementation design, successes and lessons learned are documented.

2. Company Description

Technophobe (a pseudonym) is a mid-sized company of 800 employees in the oil and gas industry in Alberta. Employees are located throughout the province, in seven main centers and numerous smaller offices. While most jobs in this company were originally hands-on, they now involve a fair bit of computer work on a daily basis.

A computer skills assessment completed in 1998 determined that employees considered themselves novice computer users. These figures stand in direct contrast to the sentiments expressed by many team leaders and managers that "their employees are computer illiterate and would never use any form of computer based training."

Despite the general computer skill level of most employees and the presence of a corporate Intranet, most employees were, in fact, quite web illiterate, as we discovered in the computer skills assessment. Employees rated their web browser use (Netscape) as very little. Additionally, the corporate Intranet was not being used for any sophisticated database or communications applications. It was mainly a static location for information, much of which was outdated and not accessed consistently by most employees.

Training in this company was split between in house developed and delivered training and training delivered by equipment vendors. Most training was centralized out of a southern Alberta office and run by a Learning/Training team there. Training courses ranged from a few hours to five days in duration. The most utilized training technique was lecture, followed by hands-on sessions in equipment labs. Training was "grocery store" in that employees would pick from a list of courses offered by the Learning/Training team. While this team acknowledged the need to move from a training focus to a performance or learning orientation, that shift was taking place slowly, if it all.

3. Rationale for introducing WBT

The decision to convert training to modules delivered over the corporate intranet was a result of formal feedback received on course evaluations; informal feedback from field employees who had discussed issues with the team's learning consultants; and informal feedback from team leaders during meetings. Many writers have noted the benefits of web-based training and the organizational issues it addresses. Gayeski (1998) suggests that "Many of the problems of conventional training and job aid approaches, such as difficulty of updating, cost of distribution and duplication, challenges in scheduling training and finding necessary content, and barriers to providing just-in-time information are now much easier to overcome." Wilson (1999) suggests that the benefits include cost savings, increased productivity, no fear, fun, and continuous tracked learning.

The issues identified by the employees/leaders in this company were similar to those cited in the literature:

- Time away from work to attend training. This company, like many others, had undergone several rounds of downsizing. Taking employees away from their jobs to travel to a two or three day training program was a major concern.
- Travel costs of attending training. Many employees would travel a day in each direction to attend courses.
- The utilization of training results. Employees often did not use the knowledge or skills from a course for months and, therefore, would forget what they had taken.
- Requests for training to be held in rural areas. Due to the above factors, many of the rural areas requested that training courses be held in their location.

WBT also addressed the following issues from the Learning/Training team's perspective:

- Difficulty maintaining current training materials. Because of the traditional labour intensive instructional design approach used by this company, finding the time and resources to keep materials updated on an ongoing basis was a challenge.
- Difficulty in finding instructors to deliver the course. Most trainers were content experts seconded from their regular positions in the company to assist the Learning/Training team with the development and delivery of courses. With downsizing, these individuals became less and less available to train. Many courses were cancelled due to an instructor not being able to keep his commitment to deliver a training course.
- Cost of instructors and meals.
- Course cancellations due to low enrollment.
- Labour intensive aspect of organizing training events.

Additional benefits of WBT that we thought would also impact our project:

- Development Costs - The development time for an online module is about the same, but implementation and delivery are cheaper. The cost of updating materials is substantially less.
- Ease and expediency of updating content.
- Convenience - Anyone can access the modules at any time, so there is no need to schedule events.
- Strategic use of instructors.
- WBT is more interactive than a lecture delivered by an instructor in a classroom.
- Flexibility - Employees can schedule their training in chunks and build it into their work schedules.
- Employees can return to modules as often as they like to review content.
- Large-scale distribution of materials is not necessary; they can be accessed from any location.
- Prepares employees for continuous and self-directed learning. Training opportunities now exist on the WWW on almost any topic.
- Integrates with other online job tools/processes/company handbooks.

4. Implementation Process

Our implementation started with a "train the trainer" process. Tammy assumed that educating the current Learning/Training team members and local training coordinators about online education and WBT would facilitate them being able to build in appropriate web solutions as part of their ongoing work. An 8 week course delivered entirely online through a web based conferencing system was held, but participation was uneven and most people did not finish the course. The reasons given were that they did not have time to devote to the course. Upon reflection now, the other reason this approach did not work is that participants were quite web illiterate and needed some kind of concrete example of WBT taken from one of the existing courses already held in the company. Without this, they could not see how WBT could become a training solution for them.

What did happen, however, is that Gregg was in this course and was one of the few to finish the course. He put together a number of sample WBT modules from his own work context. At the same time, a major cross-functional training project was underway by the Learning/Training team, which was being stalled because of implementation issues, many of which are documented above in the "Rationale" section.

We brought together a focus group of employees who had taken this training and showed them the WBT demos. The suggestion was that we would reduce the 5-day training course to 10 modules delivered over the corporate Intranet, followed by a 2-day lab. Response was favorable and so we converted ten modules. The focus group also noted that this would be a great way to complete some of their government mandated safety training - Workplace Hazardous Management Information System (WHMIS) and Transportation of Dangerous Goods (TDG).

Our initial scope was to convert an existing course manual for use as a self directed online course. It became apparent early in the project that the material we were to convert had the following characteristics:

- ➢ The manual was designed as support material for lecture based delivery rather than to provide a self-study tool. It was a compilation of information from several sources that had been formatted but not edited for continuity or flow. There was little or no transition between sections of the manual. Continuity and flow, apparently, were left to the skill of the instructor delivering the course.
- ➢ The objectives had been added to the course material as an after thought rather than being used as a design tool. Consequently there was often little or no correlation between the stated objectives of the modules and the content provided.
- ➢ It became apparent that there was a great deal of information that was either secondary or totally unrelated to the objectives when we finally determined what they were.

Based on basic instructional design theory and the available information on applying it to web based teaching instruments (see for example, Jakob Nielsen's web usability guidelines, http://www.useit.com/; the Yale Style Guide http://info.med.yale.edu/caim/manual/index.html ; King's suggestions http://www.gactr.uga.edu/internet/development.html) we decided to re-design the content and delivery to provide the following:

1. Clearly stated and accurate objectives for each of the modules.
2. Frequent learning checks and reviews that would allow learners to gauge their grasp of the content. These took the form of multiple choice questions that were evaluated by JavaScript routines so that immediate feedback could be delivered automatically. We also included buttons that displayed remediation if the learner wanted it. Review questions were interspersed throughout the content and we also compiled them into a module review quiz that was evaluated using JavaScripting and which automatically notified training coordinators of successful completion. In some cases, the form that was generated on successful completion of the test also updated an online database so learners and coordinators could track a learner's progress through the modules.
3. Content that was reduced to main ideas that could be displayed and explained on a single screen. This was done to reduce the need for the learner to scroll through large pieces of textual material. This proved to be quite effective but it did require good planning and content layout to ensure that the flow from screen to screen was logical and effectively transitioned. In some cases, a single idea or concept could not be covered in a single screen. In these cases, we presented the concept with a bold heading on the initial page and on subsequent pages, the same header appeared in a smaller font in the upper left corner of the page. The idea here was to keep the learner well oriented.
4. An interface that allowed learners to stay well oriented as they went through the course. We used a three-frame screen layout to accomplish this.
   - ➢ A side menu frame provided links to each of the units within the module as well as the module home page, feedback form, and module test pages.
   - ➢ A header frame contained the unit title and the navigation buttons for the specific unit being viewed

- A content frame displayed the actual course content. In some cases the content frame was further divided to allow learners to use links from an image map on one side of the frame to bring up explanations on the other side of the frame. This was especially effective when offering explanations of equipment or single line process flows. The intent from a design perspective was to keep the learner oriented by providing the information without requiring the learner to leave the current page. In the event that we needed to display a larger text intensive document, we generally presented it in a new window with a header frame to allow easy return to the main course material.

We coded the main title page to present the content in a bare window (without menu, navigation, or location bars) to allow more screen space for content and also to create a greater sense of being "inside" the course. Navigation was provided and controlled by the JavaScripting in the header html files. We also provided a module map in most cases that offered a graphical representation of the module and links to the individual units by clicking on them in the image.

After the conversions had taken place, we set up a pilot where one group of employees took the 5-day training and a second group took the online modules and a 2-day lab. Feedback from the pilot participants and instructors included the following benefits:

- Employees can work online modules into their "down" time.
- Employees can integrate modules into job shadowing.
- Employees were better prepared for the lab portion of the training.
- Employees could review the modules as often as they liked.
- There was a better retention of information because employees worked through the information in "interactive chunks".
- Employees liked the modules. Several of them commented on the effectiveness of the animated gifs we used for equipment explanations. Instructors, who felt that this interactive component was more effective than they had been in presenting some concepts, also noted this.
- There was a more strategic use of instructors for the hands-on, lab portions of the classes.
- Employees outside of the immediate target group for the training were able to access and utilize training. Some interested head office staff started to access this training and take it.
- Modules were integrated with company manuals/policies on the Intranet.
- Training was tracked online.
- There was a substantial dollar savings. $14,160 was saved delivering the course with online modules and a 2-day lab as opposed to a 5-day program.

We did not put together any sort of communication plan to inform the entire company of these modules, but word of them spread and we were approached by several other groups to help them use WBT for training they needed implemented. This eventually included the WHMIS and TDG mentioned above and a Quality Systems training program which was required as part of the implementation of government initiated changes to one of the company's core processes.

While we did have plans to officially roll out this training after our series of pilots, the company went through a corporate merger and all work in the WBT area was halted. We sent out an email message to team leaders across the company in December 1998 informing them of the online modules. To date, people are still "finding" the modules and completing them, as evidenced by the online database we created to track participation.

5. Issues Encountered

Gayeski (1998) notes that the adoption of new media fail because of an interplay of factors such as technophobia, inhibition of human contact, disruption of legal/economic status, lack of appropriate designs and advice, technology that doesn't work reliably, no standardization, and lack of local production ability. Many of these factors were at play in our own project and included:

- Computer anxiety encountered by some employees. Some of the employees had never used a web browser and so we would spend an hour on the phone guiding them step by step to the location of the online modules.

- Effective communication vehicles for letting employees know of the training available. To date, we have not utilized a company wide roll out of training. It continues to be "found" by people.
- Perception problems - Leadership must realize that being at a computer is a "legitimate" training activity. Many employees reported frustration that their team leaders thought they were wasting time while they were going through the online modules.
- There were challenges with some employees who were not self-directed when it came to their own learning. They were used to being told when to attend a training session by their team leader and being told what was important by a trainer in a classroom. Taking the initiative to access these modules as part of their own ongoing learning and development was a significant paradigm shift.
- Format limitations for content in current browsers. This company's LAN infrastructure was NT based with the standard desktop being a 486 DX 66 PC with no soundcard. The standard browser was Netscape Navigator Version 3.02. This prevented the effective use of full multimedia or proprietary plug-ins in the design of training software. With limited support from the IT department in the early phases of the pilot, it was determined that what interactivity we could build into the software would be developed using client side Java Scripting. This allowed for a high degree of control by the learner over the flow of the training and for the inclusion of review questions and exercises that could be evaluated and remedied immediately.
- Bandwidth/browser limitations prevent use of full audio/video. In the absence of video and audio capability, we elected to use animated gifs extensively for those units and modules requiring detailed explanations of the functioning of various types of equipment. This format had the advantages of simplicity of development and ease of downloading. The size of the animated gifs used ranged from 30kb to 92 Kb with the majority falling into the range of 40 Kb to 60 Kb. This allowed relatively short download times when compared to comparable avi or mpeg format animations and required no special software or plug-in to view.
- Some employees do not have reliable access to the Intranet. A number of northern employees dial in on lines that are not stable.
- Employee assessment is limited and based on the "honour" system. The primary advantages of the WBT produced were the universal access on a 24-hour basis and the elimination of the need for structured classes and examinations. Inherent in this design is the potential for collaborative answering of exams, or simply having an "expert" enter the answers on your behalf. Our discussions on this aspect of WBT have led us to the conclusion that employees choosing to cheat will find a way around any of the safeguards the developer can install in a program. The solution for total security of examinations, for now at least, may reside in the use of scheduled examinations at central locations. In our experience, the problem has not been considered significant enough to justify the added expense and resources required to resolve it.
- It is necessary to ensure that content in an online course is concise and complete. Strict adherence to the principles of sound instructional design is critical to success. Much of the material in modules that we converted from existing courses to WBT was poorly organized and contained a lot of extraneous information. After beginning the development based on the stated objectives we were told "Don't go by those objectives; we just stuck them in afterwards because someone said we needed them." There were a few issues that had to be worked before the subject matter experts agreed on some realistic objectives and fully grasped the concept that sometimes "less is more".
- One of the primary advantages of WBT is the ease of access over a wide geographic area. That can also pose some problems in the area of tracking and recording completions. A necessary part of each of the modules and courses we developed was the development of the infrastructure to manage it. We relied on automatically generated e-mail and CGI based administration databases. Training administrators had to be taught how to deal with these systems.

6. Lessons Learned

- Employees are more eager than management. We initially looked to management for a go ahead on this training, but their perspective was that employees would not want to and did not have the skills to complete training this way. In fact, once employees were given an orientation, they were quite happy to complete it via the Intranet, as it reduced their travel time and allowed them to spend more time at home with their families.
- The online modules must be rolled out with a face to face (f2f) orientation. Initially, we tried to use email to inform people of the training and get them to try out the modules. This had limited success. We should have done a "road show" to every main area in the province and done a f2f demonstration. Whenever we actually

showed employees the modules, they were quite keen and followed up. Whenever we would send out an email, it was largely ignored.

- Start with a quick win first. We stumbled across the mandatory training halfway into our project. In hindsight, choosing a course that can be developed relatively quickly and must be done every year may be the sort of quick win to kick-start WBT. Choosing a project that is comparable to the CBT training that many companies use for common regulatory training has the added advantage of providing a realistic assessment of relative development costs. A WBT course on WMHIS, for example, might cost $8,000.00 to develop online as opposed to $40,000.00 for traditional custom developed CBT produced using proprietary development software.
- Involve as many employees/trainers as possible in the pilot sessions. We found that once people viewed the online modules they were quite excited by the potential and they then became initiators of future projects. These projects (e.g. WHMIS, TDG) have been well received and easier to implement than the ones that we initiated.
- Look to the change management and organizational development literature for guidance when introducing WBT to a company. We didn't realize at the time (although it seems quite obvious now!) that what we were trying to do was a significant change initiative in a company, not just a slightly different way of delivering training. The actual conversion of materials to WBT was the easiest part of the project!

7. Future Considerations

Our project was halted before we could implement some solid evaluation in terms of learning outcomes. Although we have anecdotal reports that WBT is as effective or even more so than some of the f2f training sessions held in this company, we do not have any solid data to substantiate this.

8. References

Cohen, Sacha (1997) Intranets uncovered. *Training & Development.*

Driscoll, Margaret (1998) How to pilot Web-based training. *Training & Development.*

Eline, Leanne (1997) IBT's place in the sun. *Technical Training.*

Gayeski, D. (November, 1997) Predicting the Success of New Media for Organizational Learning: How Can We Avoid Costly Mistakes? *Educational Technology.*

Gayeski, D. (1998) How to Use the Internet and Intranets as Learning and Performance Tools in Silberman, M. (ed). *The 1998 McGraw-Hill Training and Development Sourcebook.*

King, Kathleen. (June, 1998) Course Development for the World Wide Web in B. Cahoon, (ed). Adult Learning and the Internet, *New Directions for Adult and Continuing Education.* San Francisco: Jossey-Bass.

Pieterse, Johan (1998) Web-based Training in a Nutshell. *Finance Week.*

Stringer, Ernest (1996) *Action Research: A Handbook for Practitioners.* California: Sage.

Wilson, Jack. (1999) Internet training: The time is now. *HR Focus*, March, 1999.

Wynn, Pardner (1997). Delivering quick-response IBT/CBT training. *Info-Line.*

Applying Social Navigation Principles to the Design of Shared Virtual Spaces

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Abstract: A shortcoming of the World-Wide Web is that users get the perception they might be alone in information space. We see a strong trend to more populated information spaces that increase one's awareness of other people's activities. This awareness is beneficial to judge the utility of certain information, its recency and its rate of change. We modified a collaborative Web server to enhance the user's feeling of being part of an active virtual community. These modifications extend the server into a social navigation system, which allows us to study how people react to improved awareness of other people within an information space. Our experiences suggest that the awareness information gives a good feeling for the rate of change and for the level of activity in a site and helps people find information of current interest. We further describe how social navigation principles can be applied in the design of an online store to buy food. Food stores are very social places and the design of virtual food stores needs to incorporate social aspects much more than online stores typically do.

The Web is a lonely place

Although many people may access a Web site at the same time, the Web mostly maintains the illusion of a dedicated resource. The only indication we might get that a large number of people access a site at the same is a slower than usual response time. Although humans are very social animals, most of our social skills are ignored and unused on the Web. Virtual communities and chat systems are only small pockets of social activity in a sea of anti-social information spaces.

Navigation is a social and frequently a collaborative process [Hutchins 1995]. Research in social navigation tries to make better use of our social abilities to navigate information spaces. Social navigation can be direct, when people give recommendations or guide each other, or it can be indirect. In this second form of social navigation the system creates a feeling of awareness for other people's activities and indicates where people went and what they found interesting. This kind of information, when incorporated into the information space itself can be valuable navigation tool see [Dieberger 1997] or [Munro et al. 1999].

Social navigation processes are very common in everyday life. Simple examples are the number of cars parked in front of a restaurant as an indication for its popularity and the length of a waiting line outside a theatre. We often base the choice of a movie or restaurant on friends' recommendations or on articles written by well-known critics. Most people would prefer choosing a dentist on a friends' recommendation, rather than picking a dentist from the phone book. The same is true for buying cars, selecting books and sometimes even meeting people.

Empathy is basic to human thinking. Usually we assume that other human beings, animals, and sometimes even inanimate objects, are intentional creatures with emotions and interesting relationships to others and us. A large part of typical conversations concerns discussing why people have performed certain actions, or what their intentions could be. Some researchers, e.g. [Dunbar 1998] actually claim that social "grooming" and its evolutionary advantages caused the development of the large human brain and complex language. Also the success of chat rooms and Web bulletin boards shows that people feel a need to interact and to share thoughts and information.

What is interesting for other people is probably of some use to us, especially if these other people are in a community that shares certain interests with us. This reasoning forms the basis for recommender systems, which are a branch of social navigation systems [Resnick & Varian 1997], [Shardanand & Maes 1995]. Furthermore we know that recency of access to information is an excellent predictor for future access [Pitkow 1997], [Pitkow & Pirolli 1997]. It is reasonable to assume that a system that actually shows what information is accessed can improve a group's focus on documents or general interest.

A collaborative Web server

As first example we describe modifications to a collaborative Web server, called Swiki, standing for Squeak-Wiki. Mark Guzdial of the Georgia Institute of Technology has implemented it in Squeak (a free dialect of Smalltalk) based on earlier work by Jim Cunningham (Wiki Wiki server) and influenced by Tim Jones's WebTalk system. What attracted us to the Swiki is that fact that every user can easily modify and extend pages. It thus forms a middle ground between a Web server, a bulletin board and a collaborative writing tool.

To modify a page on the Swiki (or Co-Web, for cooperative Web) a user clicks a link called "Edit this page", which brings up a simple Web form with the content of that page. Pages consist of plain text, but people can use HTML if they like to. The ease with which people can contribute on a Swiki server makes it an ideal tool to support collaborative writing, open discussions etc.

We decided not to password protect the Swiki. One might fear that a completely unprotected server would get easily be abused by hackers. In practice rarely happens on any Swiki, probably because hackers don't perceive a challenge in breaking a Swiki.

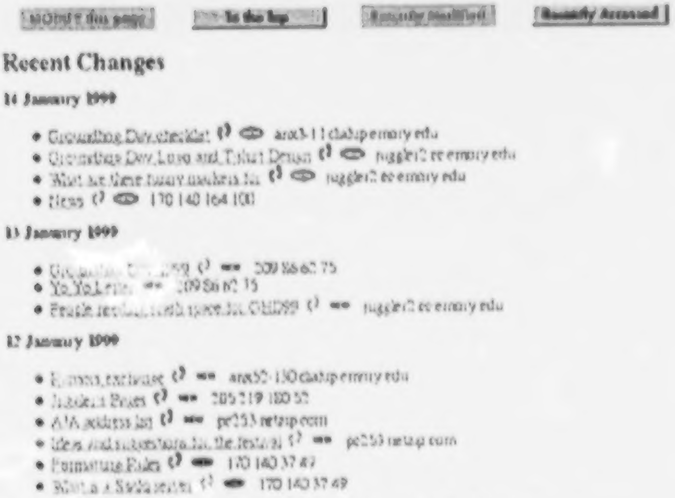
The first author modified the Swiki to be a social navigation system. Among the modifications is a different layout of the pages. We also eliminated several Swiki features to further simplify the system. Instead we added functionality to enhance the awareness of the community's activities.

From dead spaces to socially enhanced places

All Swiki servers maintain a list of recently modified pages, but as there are many more consumers than producers this list doesn't give a good indication of the activity of the community [Figure 1]. Our most significant change to the Swiki is a feature that marks every link leading to modified pages. Hand-coded "new" markers appear on many Web sites, but they seldom give a good indication for the newness of the information. Also they are hard to maintain. On the Swiki we show 3 levels of newness. Pages that have been modified within the past 24 hours are pointed out with a different marker than pages that have been modified within the past 3 days or pages changed within the past week. In addition, we point out links that indirectly lead to new or modified pages (2nd level what's new marker) and thus point out paths to new information [Figure 2].

Social navigation information always has to be seen in context. As the system maintains the markers automatically it is guaranteed that the markers are up to date and show correct information, wherever a link is placed. Therefore these markers are visible also in the list of 'recent changes' [Figure 1]. The markers thus provide social navigation information both in a global as well as a local context.

Originally we used more levels of newness for pages that were modified up to 2 weeks ago. We soon discovered that more than three levels don't really add to the system, but are even distracting. We also found that recency information beyond one week was relatively useless in our community. However, each virtual community is different and its level of activity changes over time. Our simple implementation does not take this into account. We plan to implement activity markers that adapt both to the level of activity and the rate of change within a community.



Recent Changes

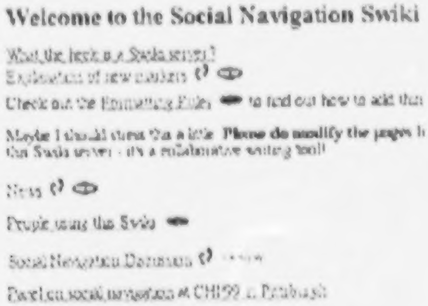
14 January 1999

13 January 1999

12 January 1999

Figure 1: List of recently modified pages

So far we discussed only functions that show what information is new but those don't give an overview of the general activity in the community. This information is visible in two ways on the Swiki. As a global activity indicator we maintain a list of "recently accessed pages" [Figure 3]. Secondly we use symbols of footprints to point out links leading to pages that have been used within the last 24 hours. These footprints are not a property of the link itself, but of the page the link leads to. This approach is significantly different from the "read wear" markers used in the Juggler system [Dieberger 1997], where you could follow a trail of heavily used links to information. A Swiki footprint instead shows aggregated usage information for pages over all possible paths to that information.

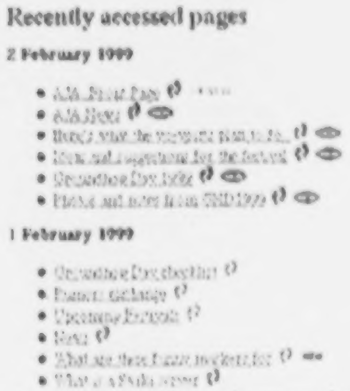


Welcome to the Social Navigation Swiki

Figure 2: Typical Swiki page

We use 3 levels of footprints. For pages that had no access for over a week we show a little dinosaur. At first the dinosaurs were implemented as a joke, but we soon noticed, that they are an excellent tool to show whether a community has more or less died out or whether certain subjects are of no interest any more. An example of such a situation is shown in [Figure 4].

We found that the footprints and dinosaurs give a pretty accurate feeling for the activity of a virtual community. The reason for pointing out accesses within the past 24 hours is [Pitkow & Pirolli 1997], who found that Web pages that have been accessed within the past 24 hours are likely to be accessed again.



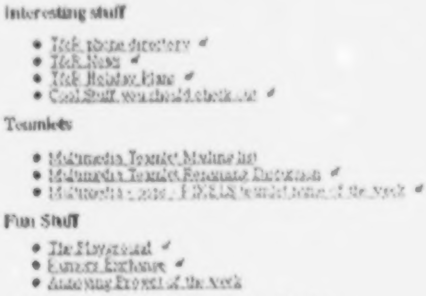
Recently accessed pages

2 February 1999

1 February 1999

Figure 3: List of Recently accessed pages

The Swiki also has a couple of other features that support social navigation. For very active communities we provide a function that shows the activity within the past 5 minutes. We recently added a Java-based navigation popup, which provides fast access to all links on a page and visualizes both newness and the footprint levels for every link. This tool also uses sound to convey footprint information. As was to be expected, some users find the sonifications very useful, whereas others found it confusing or even annoying.



Interesting stuff

Tounlets

Fun Stuff

Figure 4: Inactive Swiki

Like many social navigation tools, our modifications of the Swiki seem to be most useful within a small closely knit group of users, for example a small work group, where people are aware of each other's interests etc. We do not think that the model of the Swiki can or should be used on very large Web sites or even the entire Web. Instead we see the Swiki modifications as a useful enhancement in collaborative Web sites for virtual communities. Examples are Web supported courses or project teams, where there are shared interests and common goals for the use of the information space and where people know each other.

On-line shopping for food

In our second example we look at a larger community, where people are likely to be unknown to each other and where the social aspect is less obvious. One such domain is on-line food shopping. Existing on-line food stores are 'dead' spaces where users simply specify how many milk packages, etc. they want sent to their doorstep. There is no indication of other users and no feeling of a social place like in a physical food store. [Richmond 1996] found that users in virtual store crave the social aspects of a physical store, that they want to socialize with other people and desire a multi-user experience. Shoppers in a Stockholm on-line store frequently travel to the corresponding physical store in order to get a better picture of the items. They also want to get an impression of the store's personnel – probably since this makes the on-line store come alive with imaginary people, so that it is no longer a dead space.

We could approach the design of an online food store using a 'traditional' view of human-computer interaction and ask how to make it easy for users to find the items they need, put them in their shopping basket, and make sure they get delivered at the right time. We could also approach this design from the aesthetic side or whether the design allows users to be 'effective' etc. While all of these design considerations are highly relevant and should not be taken lightly, they are all based on a one-computer-one-user view of interaction. Food shopping is a very social process. Using social navigation features we try to socially enhance the virtual store.

First of all, we assume that other people are 'around' in the store so we get a lively space where (in some way) the user can see other shoppers moving about, can consult or instruct specialist agents and 'talk to' the personnel of the grocery store. Perhaps more interesting is the question how to accumulate trails of people in the store to visualize community preferences or recommendations. In the context of the food store, recipes can function as accumulated pieces of knowledge. Through our choice of recipes – which in turn influences our shopping list -- we convey a lot about our personality, which culture we belong to, our habits, etc. Making recommendations on which food to buy based on recommending recipes is an interesting functionality in itself. Imagine adding accumulation of user behavior so that we understand which groups are most likely to choose which recipes.

In the online food store currently being designed at SICS a user will get a recommendation for a recipe, based on popular downloaded recipes in the community for category of people the user is in (for example vegetarian). The user can add the recipe to her shopping basket, which in turns adds the ingredients from the recipes to the list of items that will be delivered to their doorstep. The user can ask for the next-best recipes that fits with her category of users – much in the same line as Amazon.com recommendations ("other people who bought this book also bought these books"). The recommended recipe will be chosen on the basis of three different characteristics that the user can manipulate: the group of users that the current user belongs to, the category of food (Italian, Thai, etc.), and any particular ingredient that should be included (shrimps, beef, etc).

The problem with recommendations in general, is that they provide the user with very little insight into who else is in her group why she was placed there. Therefore we decided to put an editor back into the loop. The editor will look at the clusters of users (based on which recipes they have chosen) and label those with fuzzy names that conveys somewhat of their content. Examples of such labels might be vegetarians, light food eaters, spice lovers, etc. The user can then in turn choose to have a look at the recommendations done for another group of users that she does not belong to. This way, she can try out being a vegetarian for a week and get some insight into the inner workings of the recommender system [Höök 1999].

The shopping system will also provide comments (and discussion of recipes), an optional image of the person who contributed the recipe, an image of the dish etc. to provide richer social trails on top of the recipe. Our solution will provide the users with more insight into both the social trails of their own actions as well as other users' actions that have lead to the recommendations they finally get.

Related work

Our work touches only a small facet of the field of social navigation. Despite the name, social navigation is concerned with all forms of decision making based on the behavior and activities of other people, not only on navigation activities. One is tempted to put social navigation into one basket with recommender systems, but this would be an oversimplification. However, recommendation based systems, like Amazon.com's book recommendations and earlier work on recommender systems, for example [Shardanand & Maes 1995] are important aspects of social navigation. Other directly related work is the study of how people perceive spaces and places [Dourish & Chalmers 1994], [Erickson 1993], and Dourish's and Dieberger's chapters in [Munro et al. 1999] or work on visualizing histories, for example [Wexelblat 1998] and the original work on history-enriched information spaces in [Hill & Hollan 1992].

An interesting aspect of indirect social navigation is the aggregation of information. It helps avoiding some of the issues recommender systems struggle with, in particular issues of trust and privacy see Dourish's chapter in [Munro et al. 1999]. Another aspect of social navigation concerns the design of the environments and the difference between virtual space and place. The design of a virtual community can shape opportunities for action and understanding for permissible or frowned upon activities which has obvious impacts on systems like the Swiki and an online shopping mall and again gives context to the activities of the user population -- see Dieberger in [Munro et al. 1999].

Summary

We see a wide range of application of social navigation. They give not only useful information for making decision, but create a sense of community, and belonging which can inspire people to return. Besides social navigation's utility in shopping systems and small, closely knit cooperative communities, showing usage within a community can also be useful in education systems, or any system where certain members of a community might act as trailblazers through information. Instructional systems can show the paths of experts through an information space to guide novices without restricting deviating from an established "path".

We mentioned the importance for context for information. Information on who is accessing information and who isn't can be as important an aspect in navigation as the validity of the information itself. Harper describes an example in [Munro et al. 1999] where an information source was not considered useful, because the 'people who count' didn't use that particular resource.

For the close future we see a host of more socially enabled systems appearing on the Web. We have reached a point where people want to interact in social settings on the Web, where online resources become places instead of being sterile information repositories. Today's systems have reached a level of sophistication where they can be communication tools and interfaces to socially interact with people near and far. Social navigation is an important ingredient for making systems true social places.

References

[Dieberger 1997] Dieberger, A. (1997). Supporting Social Navigation on the World Wide Web, *International Journal of Human-Computer Studies*, 46, 805-825.

[Dourish & Chalmers 1994] Dourish, P. & Chalmers, M. (1994). Running out of Space: Models of Information Navigation, *HCI'94*.

[Dunbar 1998] Dunbar, R. (1998). *Grooming, Gossip, and the Evolution of Language*, Havard University Press, Havard, MA.

[Erickson 1993] Erickson, T. (1993). From Interface to Interplace: The Spatial Environment as a Medium for Interaction, *COSIT'93*, Elba, 391-405.

[Hill & Hollan 1992] Hill, W.C. & Hollan, J.D. (1992). Edit Wear and Read Wear, *CHI'92*, ACM Press, Monterey, 3-9.

[Höök 1999] Höök, K. (1999). Steps to take before intelligent user interfaces become real, *Interacting with Computers*, (1999), forthcoming.

[Hutchins 1995] Hutchins, E. (1995). *Cognition in the Wild*, MIT Press, Cambridge, MA.

[Munro et al. 1999] Munro, A.J., Höök, K., & Benyon, D. (1999). *Personal and Social Navigation in Information Space*, Springer.

[Pitkow 1997] Pitkow, J. (1997). *Characterizing World Wide Web Ecologies*, Ph.D. Thesis, Georgia Institute of Technology.

[Pitkow & Pirolli 1997] Pitkow, J. & Pirolli, P. (1997). Life, Death, and Lawfulness on the Electronic Frontier, *CHI'97*, ACM Press, Atlanta, GA, 383-390.

[Resnick & Varian 1997] Resnick, P. & Varian, H.R. (1997). Recommender Systems, *Communications of the ACM*, 40 (3), 56-58.

[Richmond 1996] Richmond, A. (1996). Enticing online shoppers to buy - A human behavior study, *Computer Networks and ISDN Systems*, 28, 1469-1480.

[Shardanand & Maes 1995] Shardanand, U. & Maes, P. (1995). Social Information Filtering: Algorithms for Automating "Word of Mouth", *CHI'95*, ACM Press, Denver, CO, 210-217.

[Wexelblat 1998] Wexelblat, A. (1998). History-Rich Tools for Social Navigation, *CHI'98 - Conference Summary*, ACM Press, Los Angeles, CA, 359-360.

An Associative Repository for the Administration of Course Modules

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Abstract: One of the main difficulties in the area of web based training systems are expensiveness and great efforts that have to be invested in production of good courseware modules. While the problem of creating new pages cannot be solved easily, costs can be reduced by providing efficient methods for reusing already existing material. In this paper we will introduce a concept to collaboratively and adaptively administrate modules that may reside either internally or externally. This idea can also be extended to fully automate the creation of whole courses or information units consisting of a certain structure and dealing with a specific topic.

1. Introduction

A system called GENTLE (GEneral Networked Training and Learning Environment) [Dietinger et al. 1998a] is currently being developed at the Institute for Information Processing and Computer supported new Media which deals with many aspects of web based training. Its main purpose is to provide an integrated platform for students and teachers that offers all functionality that is required for web based training, like communication and collaboration tools, course and user administration, etc. Most of this functionality has already been implemented or is nearing completion. However, we decided not to develop a new authoring application for course modules because there already exist numerous good ones on the market. Our intention is to improve integration of those tools and even more important to provide methods for easy administration and reuse of already existing materials: The creation of high quality courseware is still quite cumbersome and expensive and superfluous work like recreating an already available module should be avoided.

The demand on such a module repository is flexible categorization and thus ease of location of required information and modules, in combination with simple usage. Especially efforts that can only be accomplished by IT and domain experts have to be reduced to an absolutely required minimum and substituted by automatic methods like computerized generation of content description, or incidental tasks that do not bother users. It also has to be considered that not all data may reside within the system, but can also be found externally at a different place or just somewhere on the Internet. This means that the system does not have control of outside modules and thus might not modify or add e.g. meta data. Additionally, external information may be dynamic and change without notice. Nevertheless, it might be valuable to include this kind of information because of topicality and quality.

Another important feature is personalization: by this we mean that a group of users (or a single user) may have their own view about the meaning of some modules, because the same data can be used differently in various situations: E.g. a chapter about multi media concepts might be introductory or advanced material, depending on the course topic. This can only be accomplished if situation dependent meaning and object oriented properties like title, creation time, author etc. are separated, because the first one can change with the point of view. Adaptive views can also be used to automatically suggest certain modules to authors if they specify a course profile that describes the meaning and aim of the course by e.g. a table of contents etc. The system can achieve this by trying to match the profile. This information about the course can also be used for suggesting suitable courses to students, if students also own a profile about their preferences.

The whole system could not only be used to find appropriate course components but also for retrieving relevant information in more general terms, like a background library for students or within a knowledge management or intranet system to be used by employees. In the following chapters we will examine already existing strategies and present a concept for an adaptive, associative, joint, dynamic and location independent module and information repository.

2. Meta Data Alone are Not Sufficient

The most obvious storage of categorized data is to save it in a data-warehouse with a static hierarchical structure similar to the file system organization of a PC. For example the History of Hypertext and data about HTML are saved in the Hypertext subcategory, which belongs to Hypermedia that is categorized under Computer science. Such inflexible data organization brings many disadvantages. The static keyword categories must be very precisely specified and regularly updated and reorganized, so that categorizing and storing of data can be efficiently supported. Otherwise stored data cannot be found again because they have not been categorized properly. Such a complex structure results in poor performance.

A possible solution to avoid the inflexibility of mentioned hierarchically structured data-warehouse is the usage of metadata. Nowadays, there are many standardization initiatives e.g. Dublin Core, Warwick framework, LTSC, IMS and others, trying to define the metadata structure [Weibel et al. 1998][Daniel et al. 1998][Hodgins & Wason & Duval 1998]. The standardization efforts are coming from different backgrounds e.g. technology suppliers, aviation industry, learning technology users, etc.. Because all of the different initiatives are aware of the great importance of the metadata for categorization, structuring of knowledge and finding relevant information, they try to be compliant within reasonable boundaries of other initiatives.

One of the definitions still being discussed within IEEE Learning Technology Standardization Committee (LTSC) is that Metadata are data about data, meaning that metadata are providing us with information about certain objects e.g. documents. This additional information about the objects can be information about the author of the object, language used, date of creation, topic, key words, possible use of the object, conditions for use, etc. We can add supplementary attributes that explain e.g. different possibilities to use the object, pedagogical values or other categories like learning style, learning level and prerequisites, which are relevant for re-use of the objects within the learning environment. Thus, metadata can be seen as a feature that facilitates finding of specific requested information (text documents, pictures, video clips, course units, etc.).

Metadata compared to the first solution mentioned in this chapter introduces tremendous improvements for the categorization and knowledge management process but there are still some problems left regarding the gathering of relevant, reliable and up-to-date information. In the categorization process different key words are assigned to the object. Exactly which key words provide the most appropriate description of the *content* or *meaning* of the object is the decision of the person, creating the metadata. This leaves the difficulty of finding the required object to the user, because it may be described in a different way than expected. The fact that equal key words have different meaning within different contexts is also causing some problems for users, who want to find a specific object. A possible way for useful and sufficient metadata can be probably achieved by combining human knowledge and technology. The disadvantage of metadata being rigidly coupled with the object can be avoided.

Grouping of metadata offers a solution to that problem. Grouping of metadata means that metadata which describe physical appearance of the object stay coupled with it. Other metadata which describe some more general concepts e.g. topic, category, key words can be transformed into separate objects. Those meta-objects exist independently and can be linked to many different objects. Meta-objects can be shared within many objects and relations can be defined between meta-objects themselves. One possible implementation of this concept is described in the next chapter.

3. The Concept of Knowledge Clusters

A cluster usually describes a collection of objects that are relatively close to each other according to a chosen criterion. Cluster analysis is used for grouping similar, related objects. One possible application of clustering algorithms is document retrieval. In a dynamic environment content changes are made also in the content indicators attached to the documents. In such cases clustered file organization is preferable because similar sets of content identifiers are automatically grouped into common classes or clusters. The search is performed looking only at those clusters that exhibit close similarity with the corresponding query identifiers. A clustered file produces fast search output.

In real life, concepts are never isolated nor very simple, so clusters may overlap allowing that data, documents or part of documents (e.g. sections) belong to more than one cluster. To get better results we can use conceptual clustering. The difference between conventional and conceptual clustering is that in conceptual clustering the entities are grouped based on a conceptual cohesiveness (e.g. set of neighboring examples) [Michalski & Bratko & Kubat 1998]. Unlike statistical clustering methods, these algorithms rely on a search for objects within same or similar concepts. As an example of conceptual clustering we can use the term *virus*. If we search for *virus* we can get as a result different documents which describe the topic in computer science or documents which deal with viruses in medicine. Using the conceptual clustering, those documents are put into different clusters because they belong to different concepts.

What we need to accomplish is a network of meta data, where each meta data object correlates on one hand with the information it describes (meta data and data may also physically be the same object) and on the other hand with other instances of meta data. We suggest to use pure meta data (without a document content), so called base terms, which are related to other base terms to describe main concepts and thus work as a seed for new clusters. To improve effectiveness and versatility relations themselves should also contain some meta data: A *type* that specifies what kind of relation exists between two nodes (e.g. sub- and super-concept, cause or result, opposite or synonym, prerequisite, introductory, etc.), a *weight value* that specifies to what degree this type applies to that relation (e.g. fuzzy values like perfect, good, average, bad etc. expressed by a certain percentage) and a *quality value* that specifies the reliability of the connection (also percentage). In this way users can give feedback about the correctness of the relation during browsing and searching of the cluster and thus influence weight and reliability of the relation. This has the advantage that a new relation need not be completely correct right from the beginning, but can converge to a commonly accepted status by collaborative voting. Thus it is not important any more whether the creator of the relation is completely trustworthy or not, it just influences the starting reliability value. That means that not all connections have to be created by domain experts but can also be created by other e.g. novice users or algorithms. If we combine these relation attributes with access rights like private, group and public access and ownership even different points of view of concepts are manageable because relations can be seen differently by different users.

Similar approaches of sharing ideas and opinions within the society and building the contacts between people who have related interests, opinions, is described in Automated Collaborative Filtering (ACF) and Semantic Transports of information [Chislenko 1997a][Chislenko 1997b]. The semantic transport of information can be seen as a social tool, overcoming the side effects of the present-day individual isolation. Implementations of some fragments of these ideas can be also found in Recommender Systems [Resnik & Varian 1997] such as Alexa (http://www.alexa.com) and Phoaks (http://www.phoaks.com/) or in new generations of search engines like Google (http://www.google.com).

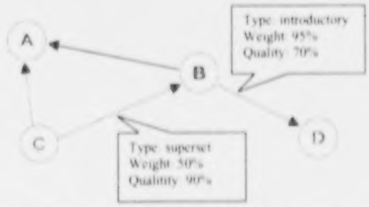

Figure 1: Examples for relation meta data

To avoid a possible confusion we would like to define what we understand by using the term *knowledge cluster*: The combination of a knowledge broker point (KBP), expert knowledge and collaborative community system as well as the automatic processing modules can be seen as a *knowledge cluster*. The task of knowledge broker points is managing static and dynamic knowledge sources within the learning environment. An automatic process module e.g. a knowledge cluster can help to categorize information entities, to position them as new pieces of knowledge in the system, and to store and to find them when necessary.

3.1 Creation of Knowledge Clusters and Addition of Documents

Typically, the creation of new knowledge clusters will be started by defining a skeleton of related base terms describing a certain knowledge area by domain experts. As all relations created by trusted experts get assigned a maximum reliability value, the quality of the network is more important than its extent and number of nodes. Additionally depending relations like "A is an introduction to B" and "B is an introduction to C" can dynamically be calculated by multiplying its weight and quality values and need not be created manually [see Figure 2].

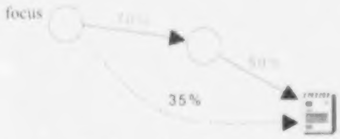

Figure 2: Determining the total weight

However, if in special cases dynamic relations do not result in meaningful values from some point of view, they can be shortened by static relations which have higher priority than the calculated ones but e.g. might not be seen by everybody, because access rights for these relations are restricted [see Figure 3].

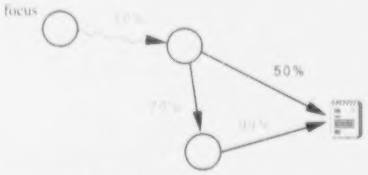

Figure 3: Modified shortest path rule

In this context we speak about a modified shortest path rule because here the shortest path is the one with fewest relations and not with the smallest edge length. It should be noted that in some instances the calculation of two paths of the same length (equals the number of relations between nodes) and same starting and ending node can lead to different results. However, this is absolutely correct because different paths also mean different contexts or conclusions [see Figure 4]!

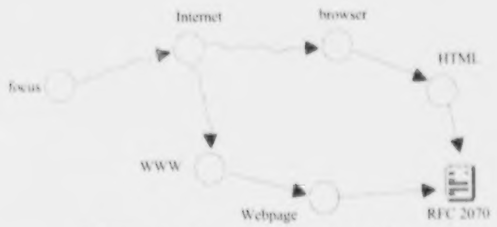

Figure 4 : Context dependant paths

New base terms, meta data (including information content such as documents and course modules, or pointers to data like references) and also relations between new base terms and meta data cannot only be created by experts but also by ordinary users or even algorithms like user profiling, content analyzer, etc. The quality of these relations then depends on the status of the user. E.g. an anonymous user or a not too trustworthy algorithm only leads to quality values that are starting quite low, whereas identified users who have gained a certain expertise within the specific knowledge area may create more promising relations.

Whenever users browse or access a knowledge cluster they should have a possibility to provide feedback whether the visited relation proved helpful and they thus found what they were looking for or whether the relations had been misleading. Such a feedback could be given just by clicking on a plus or minus sign, indicating approval or rejection, or by a more complex form where the user has the possibility to suggest a different type, weight and quality values. The feedback can also be provided by a profiling algorithm that just analyzes behaviors of users. For examples, users starting all over again with a search after following a lot of relations express with this behavior that they did not find what they had been looking for and thus that these relations in their context had not been very helpful for them. In each case, the influence of the feedback on the attributes of the relation again depends on the trustworthiness of the user or algorithm which provides the feedback. Identified users can gain higher trustworthiness in a certain knowledge area if relations and objects they created for this area get higher ranking through feedback. The effect of this concept is that the whole cluster as well as quality values of contributing users and algorithms converge into a commonly accepted status. This means that newly created relations need not be perfect right from the beginning but are 'polished' on usage. In this way, also the effectiveness of an algorithm which automatically creates new structures only has an influence on the duration as long as the resulting relations evolve to a high quality network influenced by users.

3.2 Searching and Browsing Within Knowledge Clusters

Access to a knowledge cluster starts by defining an entry point to the data structure. This can either be a common root term or more likely a traditional keyword query on the meta data stored within the base terms and relations. The list of search results can be linearly sorted by priority or even better displayed as several clusters or clouds of documents and relations that indicate which terms belong together and what are their neighboring nodes. From now on users may browse through the clusters by putting the focus on a selected term or altering the *filter* values. The filter specifies how many and which adjacent nodes and documents will be displayed and thus form a new cluster. We have the following possible filter values: type of relations (e.g. introductory), threshold values for weight and quality, number of relations displayed, visibility expressed by maximum length of path that is dynamically calculated and of course also document meta data like mimetype, creation time, author, e.g. Dublin Core attributes etc. The filter can also be used for the very first display of search results. As mentioned before users can give feedback to the displayed relations or add new ones during the browsing process.

Another interesting feature is the so-called *rucksack* which is used to store documents for later reuse or may be used to execute more complex filtering by combining items collected in the rucksack as additional filter criterions such as 'all items displayed in the neighborhood have to be a sub concept of rucksack item X and an introduction to rucksack item Y' etc. An intelligent rucksack could also log or analyze the behavior of users and define a certain task and user specific profile which can be used to foresee the next action and suggest suitable filter settings and items. Certain rucksacks or more generally speaking agents can also be reconfigured for a specific task like chapter creation (e.g. a chapter consists of an introduction, a main part and a summary) or even the creation of new clusters.

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4. The Prototype

The prototype, like the rest of the WBT system is based on the Hyperwave Information Server (http://www.hyperwave.com). In fact the concept and features of Hyperwave proved to be very helpful for this special demand, since it supports an object-oriented approach for storing documents and hyperlinks (so-called anchors). All objects within the database, including anchors, may store arbitrary attributes like keywords, owner, access rights etc.. This provides the possibility to use anchors for creating our specialized relations, because the required meta data such as type, weight and quality can be stored within the object. Further anchor-object relations are bi-directional, which means an application can find out which links are pointing to an object and which are pointing from this object to a different one which is also an important requirement. Hyperwave objects without content (like a Remote Object) have been used to implement base terms or external meta data that just have pointers to their accompanying documents. Personalization has been easily added by using access rights which are also applicable to anchors and which are used to specify which user(s) may see a relation.

Currently our prototype supports the creation of base term skeletons, adding of documents and personalized relations and simple querying and filtering during cluster browsing. Collaborative voting and the rucksack feature will be added soon. Thus the prototype can be used for jointly administrating a module repository or a reference and background library. Another simple application for the prototype would be shared bookmark archives, which might be helpful when doing task oriented teamwork like student exercises etc..

5. Conclusion and Future Work

As we have seen the concept of applying attributes to relations that interlink meta data provides a possibility to add additional meaning to course material which is a basic prerequisite for further automatic processing. Combined with situation and user dependent views and collaborative rating techniques it can be used as a fundamental model not only for managing courseware repositories and background libraries but also for administrating all kinds of related data. One of the next steps will be to examine the usefulness of this concept for adaptive tutoring which could be realized by courses that are generated on the fly and depending on users preferences. Future work will also include the integration of our ideas about dynamic background libraries and intelligent knowledge gathering [Dietinger et al. 1998b][Dietinger et al. 1999] to expand the model to a generalized and distributed concept.

6. References

[Alexa] http://www.alexa.com

[Chislenko 1997a] Chislenko A.: Semantic Web - a vision of the future of intelligent Web, (June 1997), http://www.lucifer.com/~sasha/articles/SemanticWeb.html

[Chislenko 1997b] Chislenko A.: Automated Collaborative Filtering and Semantic Transports, ideas of using the next generation of information technologies for automated meaningful distribution of knowledge, (October 1997), http://www.lucifer.com/~sasha/articles/ACF.html

[Daniel et al. 1998] Daniel R. Jr., Lagoze C., Payette S.D.: A Metadata Architecture for Digital Libraries. http://www2.cs.cornell.edu/lagoze/papers/ADL98/dar-adl.html

[Dietinger et al. 1998a] Dietinger T., Maurer H. (1998) GENTLE – General Network Training an Learning Environment. Proc. of ED-MEDIA (1998), Freiburg, and http://wbt.iicm.edu/gentle/papers/edmedia98.pdf

[Dietinger et al. 1998b] Dietinger T., Gütl Ch., Maurer H., Pivec M., Schmaranz K. (1998) Intelligent knowledge gathering and management as new ways of an improved learning process; Proceedings of WebNet98, Orlando, Nov. 7-12, 1998, Florida, USA, p244-249 and http://wbt.iicm.edu/gentle/papers/webnet98.pdf

[Dietinger et al. 1999] Dietinger T., Gütl Ch., Knögler B., Neussl D., Schmaranz K. (1999): Dynamic Background Libraries - New Developments in Distance Educations Using Hierarchical Interactive Knowledge System; J.UCS Vol 5/No. 1, p2-10

[Hodgins & Wason & Duval 1998] Hodgins W., Wason T., Duval E.: Learning Object Metadata (LOM) v2.5a, Dec. 23 1998, IEEE Learning Technology Standards Committee (LTSC), http://ltsc.ieee.org/doc/wg12/LOMdoc2_5a.doc

[Michalski & Bratko & Kubat 1998] Machine Learning and Data Mining Methods and Applications (ed.: Michalski R.S., Bratko I., Kubat M.), John Wiley & Sons Ltd., 1998.

[Resnik & Varian 1997] Resnick, P.,Varian, H., "Recommender Systems", Comm. of ACM, Mar.1997, Vol.40 No.3, p.56-58

[Weibel et al. 1998] Weibel S., Kunze J., Lagoze C., Wolf M.: Dublin Core Metadata for Resource Discovery, The Internet Society, September 1998, ftp://ftp.isi.edu/in-notes/rfc2413.txt

CoFIND- an Experiment in N-dimensional Collaborative Filtering

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Abstract: This paper reports on the development of CoFIND, a web-based n-dimensional collaborative filtering system that seeks to guide learners to relevant resources based upon not only the content of the resources but the qualities exhibited by those resources that make them useful learning material. Qualities provide the n-dimensions of this collaborative filter. Qualities and resources are generated collaboratively by the users of the system. CoFIND is designed to allow evolution to occur, which is discussed in the context of Darwinian theory and includes reference to current theories relating to the development of complex systems. The paper goes on to describe the implementation of the system and the results of an early pilot experiment involving a group of 42 students. It is concluded that, despite encouraging early results, some further work is needed to develop an effective interface and to embody the kind of complex interactions needed to generate spontaneous evolution.

Introduction

As any web-aware teacher will know, there are many excellent, freely available resources for teachers and students on the World Wide Web, such as individual web pages, whole web sites, mailing lists and newsgroups. The biggest difficulty we face in using them lies in finding good resources and, having found them, identifying whether or not they are useful in a given context for a given learner. A teacher's eye view will be different from that of a student, but each student will differ from the next in content requirements and preferred learning style. Although there may be some common measures of excellence, there are few ways to measure the relevance of a given resource to given learner. Of the available options, the methods we use can be broadly split into two main categories:

1. Appeals to authority
2. Collaborative filters

Appeals to Authority

Appeals to authority are an effective way of finding resources for learners. Recommended texts provided by teachers and references in papers can help to filter the useful from the unhelpful, as can the recommendations of friends and colleagues. The Internet extends this concept through the use of such technologies as newsgroups, email, mailing lists and IRC to provide direct recommendations. More structured variations on the theme include hierarchical directories such as Yahoo (Yahoo, 1999), which provide vetted links provided by human beings. Combined with a search engine to narrow down the returned results, this is a powerful way of getting hold of good quality and potentially relevant resources. Similarly, the opportunities to review books provided by sites such as Amazon (Amazon, 1999) allow us to share our experiences with others. Another worthwhile technology is the PICS (Platform for Internet Content Selection) system (Resnick, 1997) which allows documents to be labelled and described in a standard manner. If we trust the labellers this can work very well, although it relies on a high uptake of the system- unlabelled documents are filtered out.

The disadvantage of all such systems for prospective learners lies in our diverse learning styles. There is no such thing as a perfect learning resource for all learners. Even if we can find reliable resources in the right subject area, there is no guarantee that they will help us to learn effectively. We learn in different ways.

Collaborative Filters

An Automated Collaborative Filter (ACF) allows us to overcome the problems of differences in viewpoint and needs by automatically identifying commonalities between users of a system and providing suggestions for resources that are closely matched to needs. Based on the assumption that if you and I like the same 100 resources then we are probably going to feel similarly about the 101st, the seminal Firefly and many other collaborative filtering systems (e.g. Amazon, PHOAKS, GroupLens) are immensely effective ways of identifying resources that we will probably like or enjoy.

N-dimensional Filtering

An ACF is superb for such areas as book and movie recommendations, but starts to founder when we seek novel resources. By its nature, learning is to do with bringing about changes in the learner. It follows that matching our previous likes and wishes may not always provide us with the most suitable resources for our current learning needs. As my past list of preferences for learning resources includes many works relating to English Literary Culture, it is relatively unlikely that my current need for resources relating to Network Management will be adequately met. Given divergent needs, different learners' paths may branch too dramatically for existing ACF systems to provide much more than an approximate match to their requirements.

N-dimensional collaborative filtering seeks to build on the power of ACFs by introducing further explicit dimensions of value beyond like/dislike or good/bad into our assessment of resources. These dimensions are exhibited as the qualities of resources that make them useful to us. For instance, the qualities of learning resources for English Literary Culture might include 'comprehensive', 'good for beginners', 'amusing', 'formal' or any number of other descriptive terms that would be equally suitable as ways of describing resources relating to Network Management. In essence, a quality is something that a learner values about a resource.

CoFIND (Collaborative Filtering In N Dimensions)

CoFIND is a web-based n-dimensional filtering system that we are developing for collaboratively creating databases of URLs pointing to learning resources. It is intended to be maintained and created by the learners who use it. Although a teacher is not necessarily excluded, the system is designed to require no teacher-intervention.

Resources that have been found to be valuable in the learning process are entered onto the system by the learners themselves. Qualities are also created by the learners, as selection of qualities is too important to be left up to the 'experts'.

When entering resources, we encourage users to also enter qualities that they find useful in those resources. We then encourage all users of the system to vote for how well those qualities match not only these but also the other resources in the resource-base. Resources may thus be rated according to how well they match the collaborative sum of learners' opinions of different qualities.

Evolving a Solution

If references to resources and qualities were allowed grow unconstrained, the system would soon become clogged with less-than-useful detritus. Therefore, CoFIND has been designed to let appropriate qualities 'evolve', allowing more-used qualities to thrive at the expense of the less-used, a process which in turn affects the 'success' of the resources themselves. This mechanism for evolution is provided by a combination of ordering (more popular qualities are presented first, so are selected more often and thus thrive more easily) and planned retirement. After a configurable number of days unused, qualities are humanely 'retired'. It is still possible for retired qualities to be voted for and thus to reappear on the list, but it is made significantly more difficult for this to happen than for those that are commonly selected.

A similar fate awaits resources that receive few votes for any quality- resources naturally drop to the bottom of the list as a result of vote-starvation. However, even popular resources do not stay consistently at the head of the list, as not all qualities will apply to every resource. By providing many qualities for learners to seek we are creating multiple dimensions, allowing us to cater for many different learning needs and styles. A variegated evolutionary landscape develops where speciation can occur and there are many evolutionary niches to be filled.

Evolution

CoFIND has been designed to be self-sustaining, driven by the activities of its users. It should provide an evolutionary landscape where adaptation of qualities can occur and where there is little or no need for sky-hooks (Dennett 96) or an external agency of change. We wish it to be learner, not teacher-driven.

William H. Calvin sums up the requirements for evolution to occur as "a pattern that copies with occasional variation, where populations of the variants compete for a limited workspace, biased by a multifaceted environment, and with the next round of variations preferentially done from the more successful of the current generation" (Calvin, 1997).

Within CoFIND, qualities thrive according to the numbers of votes cast. Successful qualities get votes and survive, less successful qualities fade away. Variation occurs by users identifying qualities imperfect for their needs then choosing semantically similar or (in an analogue to gross mutation) dissimilar words or phrases which, if successful, will oust their predecessors as descriptions of what is valuable in a resource. This can meaningfully be called reproduction on the grounds that ideas will spark other related/similar ideas and words will suggest other words, a way of thinking not unrelated to memetics. Even if this is hard to accept, the fact that semantically similar qualities exist at all should result in variation and competition. There is a potential for many ecological niches or fitness peaks, which may be more or less successful, but within a range of semantically similar qualities it is likely that few will survive. For instance, if the qualities 'good for beginners' and 'simple' are semantically close then the quality that is more widely used will render the other extinct. If they are sufficiently distinct and both of some use then both can survive as they will occupy different evolutionary niches. We achieve a multifaceted environment through the many shifting requirements of the learners using the system.

Each CoFIND instance is isolated from others. Different instances of the system are installed for different subject areas and purposes. As Calvin notes, "Parcellation (as when rising sea level converts the hilltops of one large island into an archipelago of small islands) typically speeds evolution" (Calvin, 1997). However, we have found it useful to be able to transfer an existing population of resources and qualities to a new context (again, reflecting what happens when islands are separated from mainlands).

Care has been taken to ensure that change is neither too slow nor too fast. Kauffman has observed that evolution happens best at the edge of chaos (Kauffman 1995). If the evolutionary landscape is too ordered (a 'Stalinist regime') then a stagnant stability is reached and interesting change does not occur. If it is too chaotic, no high peaks of fitness are ever reached and the system slips into a state of flux. Kauffman calls this the 'Red Queen regime', where we are always having to run to stay in the same place. Several methods implemented in CoFIND help to prevent this fall into chaos. For instance, we make it easy to vote for qualities that have been selected but hard to vote for those that have not; it is deliberately difficult to adding new qualities or resuscitate retired ones; even the way that resources are displayed (slowly, five at a time) is designed to limit rapid change. Together, these mechanisms create a kind of stickiness- success breeds more success and it is fairly difficult for new species of qualities to usurp the existing dominant values. However, the system remains dynamic through the constant input of new resources and qualities, so that there is little danger of too much stability or order setting in. Getting this tuned to the right level of dynamism remains the subject of ongoing research.

A Brief Description of the System

CoFIND is written using Microsoft's Active Server Pages running under IIS on Windows NT, and uses a Microsoft Access database as its back end. To cope with a potentially large number of resources it is searchable. It uses a basic pattern matching search engine that looks through the descriptions and comments that users have posted about resources.

Upon logging in to the CoFIND system, a user is presented with a screen providing a selection of qualities (by which the returned resources will be ranked) and a simple search field. The qualities are listed in order of frequency of use- those that have been voted for most appear at the top. There is no requirement to enter any quality nor any search term, but unless one or both are entered the result is an unordered list of all resources in the resource-base.

Upon clicking a button to perform the query a users is presented with a list of resources, five at a time, ranked according to the sum of votes for preferred qualities and matching whatever search terms were entered. Only preferred qualities are shown, with a small bar-graph against each quality indicating the number of votes already cast. A hyperlink will take the user to a given resource, displayed in a separate browser window so that CoFIND remains available. Hyperlinks also provide a mechanism to vote for resource/quality combinations.

Users can quite easily add resources on a form that also provides a means to reinstate retired qualities. It is *possible to add comments to existing* resources, providing a mechanism for effective use of appeals to authority as well as ACF.

For a given link, a detailed page may be selected listing comments and giving a detailed breakdown of who has voted for a particular resource as well as its overall profile of votes for all qualities. The page also gives further information indicating the pattern of votes for the resource and specific information on each individual vote cast.

An Example Use of the System

CoFIND has been deployed in a number of environments so far. Users of the system range from an international group of teachers and trainers of Object Oriented languages to final year students of network management and a group of lecturers with a shared interest in learning technologies. Further uses of the system are planned for the near future, including application to the needs of language students.

The results presented here come mainly from a short self-contained assignment for to a group of forty two postgraduate students who were required to design network, a task that would require significant research to complete. The students had participated in a pilot trial of the system for one week prior to the start of the assignment. CoFIND was provided as a database of resources relating to the assignment, and students were offered up to five percent of their marks for their contributions to it, whether adding resources or commenting on existing resources. They were also asked to use the database to submit the URLs of their finished reports.

We had primed the system with three relevant resources and seven qualities ('interesting', 'useful', 'reliable', 'informative', 'a good gateway to further resources', 'of broad coverage', 'accessible') that had arisen in the earlier trial session. Throughout the experiment, conscious of the need to avoid behaving as a skyhook we did not make further contributions, despite strong temptation. We see the starting state of the database as simply part of the shape of the evolutionary landscape. We are interested in the dynamics of the system, what happens next rather than how it came to be.

Some Results

The system was very popular- comments along the lines of 'we should have had something like this for the entire course' were common. The main appeal to students was that it was a searchable collaborative resource database- a shared space for storing useful URLs and associated comments. From a user perspective, CoFIND is only a little different from a traditional search engine and indeed some students added qualities that made it behave that way- for instance 'about firewalls'.

Thirty-six out of the forty-two students discovered over seventy relevant resources over the two week assignment with a range and quality far surpassing the authors' attempts spanning several years to build a similar list of links. All the remaining students made comments on existing resources, indicating that they had spent some time looking at them.

Although the system is designed explicitly for resources that can be specified with a URL, it proved flexible enough for one of the students to use it to recommend a book- the ensuing votes and comments showed that this was a very successful choice.

Growth of qualities was generally restrained. Only a few new qualities were added to the original seeding values until the final hand-in day, at which point a Cambric explosion of qualities occurred, mainly along the lines of '"Brilliant!", "Top !" and "Spot on", all applied to the students' own work. Until that point we had suspected that the students had not grasped the mechanics of adding qualities and that we had made the process too obscure, but this showed otherwise. With sufficient motivation, qualities were rapidly added.

Early questioning suggests that students may not have added new qualities because the existing ones mostly suited their needs and they were avoiding unnecessary effort. Similarly, voting was not as common as we had expected- the process was apparently too tedious and went virtually unrewarded.

Although we adjusted the interface following feedback from the pilot trial, difficulties understanding how to vote may still have influenced the results. A similar issue was that the students were at first unsure of the difference between quality-selection and inputting search terms. One student made the comment that a resource was 'good for beginners' without voting for the quality 'good for beginners'. There are clearly some user interface issues to be resolved.

Some qualities were a lot more successful than others, with the most popular qualities gaining nearly three times as many votes as the least popular, when measured over an equal period. We believe that such qualities provide a clue as to what students really want out of their learning resources, but this is as yet not fully proven. Qualities that started successfully remained successful.

To simplify the voting process we have only provided a mechanism to allow users to agree that a resource exhibits a certain quality, not to disagree. Some students questioned this and in one of the other instances of CoFIND this has even led to the appearance of negative qualities- e.g. 'not available'.

Evidence for Evolution

Useful Qualities

Qualities rose up the list relative to other qualities. For example, the quality 'brilliant!' was initially created as a quality of one group of students' report, one day from the end of the assignment. It was immediately taken up by all the other groups as they handed their work in on the final day (clearly a successful quality when applied to students' work), and within a day of entry was being applied to other resources and appeared half way up the list.

Competing Qualities

We have as yet gleaned no evidence of a discernible effect of votes for one quality affecting votes for any other. However, the relatively short duration of this experiment and relatively small number of qualities only allows us to represent the coarsest of trends. It is hoped that we might be able to determine longer-term interactions in other experiments taking place over the next few months.

Self-sustainability

We have to ensure that participation takes place, as without it we cannot see the growth and variation required to make the system self-sustaining. Although participation was strongly encouraged in this experiment by the allocation of marks, aspects of the system which were not marked (e.g. voting) were not as widely used as we would have hoped for, partly as a result of user interface issues already mentioned. We are still seeking ways to make voting a natural consequence of using the system, either transparently or by providing an incentive to participate. For example, An ACF such as Firefly cannot recommend films unless it can identify patterns of likes and dislikes. Thus user-input is essential to use the system in the first place, but we do not have that advantage. If nothing else, voting should be simple and fast. We had hoped to leave part of the system in a small frame whenever an URL was selected, allowing the user to vote for the resource in front of them without seriously interrupting their work. However, the security model of scripting languages in browsers made this an untenable solution.

We are investigating a further enhancement to the design to allow a more volatile shift in qualities. At the moment, a quality's list-position is based solely on how many votes it has been given. An option that may be implemented in the next iteration of the tool is to make selection of qualities from the search screen feed back into the position of the qualities in the list. An advantage of this would be that no active participation in the voting process would be required, merely selection of qualities.

Other Problems

We have not given users the ability to change details after a resource has been posted, mainly because it would be too easy to cheat- for instance, a user could amass votes for a known popular site and then redirect it to their own home page. However, this makes it very difficult to deal with resources whose URLs change. No simple solution to this has yet occurred to us, with the existing mechanism requiring an email message to the administrator.

The current system for ordering resources is based on a simple count of votes for selected qualities, accompanied by a bar-graph display of those votes. This could become unwieldy as more votes are generated. We have looked into the possibilities of scaling votes, either by percentages or amalgamation, but we have yet to reach a sufficient number of votes for the issues to come to a head.

Conclusions

This is the first working iteration of our tools. We have designed an environment to allow evolution to occur but as yet we are only seeing fairly coarse changes and little evidence of complex relationships developing. In addition, further work is clearly needed on the HCI aspects of the system, particularly as it relates to managing and motivating interactions and ensuring that a sufficient range of qualities is generated. Possible avenues include providing 'rewards' (such as a mention for successful resource providers on the front page), a reduction in the number of steps and pages needed to add to the system and vote, and the explicit positioning of CoFIND as a useful bookmark repository for individuals and groups. This latter mechanism may allow selfish motives to drive the growth of the system.

However, in many ways (particularly from the point of view of our students) our early experiments are a success. Not only do the learners collaboratively generate a useful database of resources, but more valuably we are coming to know what it is that those learners desire in a resource, through the evolving sets of qualities that they seek. As providers of resources, this in turn means that we can start tuning our resources more effectively to the needs of our students, and concentrating on more relevant areas. We have laid the foundations of a self-sustaining feedback system that could result in ongoing improvements to the online resources we provide as well as putting the selection of learning resources firmly into the hands of the learners.

References

Amazon home page <http://www.amazon.com>. (1999, February 12)

Calvin, W.H. (1997). "The Six Essentials? Minimal Requirements for the Darwinian Bootstrapping of Quality," *Journal of Memetics* 1

Chernenko, A. (1997) Collaborative Information Filtering and Semantic Transports, <http://www.lucifer.com/~sasha/articles/ACF.html>. (1999, February 12)

Dron, J. (1999) MscIS CoFIND instance <http://ituser.it.bton.ac.uk/staff/jnd/mscisassignment/resource/getemail.asp>. (1999, February 12)

Dennett, D. (1996), *Darwin's Dangerous Idea*, Penguin 1996

Firefly home page <http://www.firefly.net>. (1999, February 12)

Kauffman, S. (1995) *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity*. Oxford University Press, 1995

PHOAKS home page <http://www.phoaks.com>. (1999, February 12)

Resnick, P. (1997). Filtering Information on the Internet. *Scientific American*. March 1997

Yahoo home page <http://www.yahoo.com>. (1999, February 12)

Running the Virtual High School

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Virtual High School

> "I want everyone to know that this year has been the best professional development year for me in 27 years of teaching. I not only feel part of a new wave of education but I feel that I have re-fallen in love with my subject - biology." -- Richard Clevenstine, VHS teacher, Ridley High School, Folsom, PA

> "Virtual High School is of special interest to us because it gives our Deaf students the opportunity to participate in classes with hearing students and teachers on a fairly equal basis without the need for interpreters. Students agreed that using the computer communication in VHS allowed them to feel comfortable interacting with the hearing students in their class." Joyce Barrett, VHS site coordinator, Model Secondary School for the Deaf, Washington DC

Abstract:

I. The Virtual High School Cooperative

The Virtual High School is an extraordinary project that is having a positive impact on thousands of high school students and hundreds of educators in schools across America. Like other Technology Innovation Challenge Grants, VHS is using the best of educational technologies to give students and teachers access to resources, curriculum, and training of the highest quality, and to prepare educators and learners to be skilled and confident participants in an increasingly technological world. Like other Technology Innovation Challenge Grants, VHS is bringing these benefits to more than just a select group of participants: VHS students and teachers represent a spectrum of different ages, ethnicities, backgrounds, learning abilities, and educational experiences. Similar to other Technology Innovation Challenge Grants, the effect VHS is having on education reaches far beyond the thousands of participants involved in the project. Teachers who have had access to the VHS professional development course find that they are bringing new technology skills, new teaching strategies, and a revitalized enthusiasm for teaching back into their local classrooms, thus passing the benefits of their experience on to countless additional students and colleagues. Students who have taken a VHS course find that the experience has helped them become independent learners and capable technology users, and they pass these skills on via daily interactions with peers, family members, and even teachers. High schools, communities, and entire states have found that the success of VHS has generated strong partnerships between corporate and educational entities, as well as support for additional technology and educational initiatives within their regions. VHS has become a model for similar programs across the country and around the world. In this testimonial, you will read about the simple yet powerful VHS model, and hear from VHS participants who talk about the far-reaching ways in which VHS has touched their lives.

What is VHS?

The Virtual High School (http://vhs.concord.org) is a cooperative of over 125 high schools across the U.S. that offers netcourses taught by teachers for students in the cooperative. Each school contributes teachers who, with the help of teacher mentors, instructional technology experts, university faculty, and businesses, design and offer innovative courses over the Internet. Each school in the cooperative can enroll 20 students in these netcourses for each section of a teacher's time it contributes to the pool. [This allows schools to offer a range of courses usually found only in large high schools.] Quality is maintained by requiring each virtual teacher to successfully complete a graduate-level professional development netcourse on the design and development of network-based courses. At the halfway point in its five-year grant, the VHS project is now turning from concept development to large-scale implementation.

This academic year, there are over 100 schools in the project offering 105 courses to approximately 2,000 students. In addition, over 90 new teachers from as many schools who are completing a yearlong professional development program will offer their first courses in the 2000-2001 academic year. Thus, next year, we expect over 200 courses to be offered serving 4,000 students from at least 200 schools nationwide.

VHS Course Design

VHS courses are either one-semester or full year courses, based on an asynchronous, scheduled model structured around online discussion groups. Due to its asynchronous nature, students can access the network anytime at school or at home to read assignments, participate in discussions, and submit completed work. At the same time, courses are carefully scheduled with all the students in a course participating in the same activities and thinking about the same issues. Teachers are trained in structuring and moderating these online discussions. Without this emphasis, online courses can become conversations between individual students and the teacher thereby generating an overwhelming volume of posts. This maximizes the value of the online discussions and helps ensure that students can learn from each other and construct their own understandings. This is not only good pedagogy, but it is essential to making a manageable load for the teacher.

Most VHS courses follow a weekly rhythm that includes a major topic, assigned activities, online discussions, and student contributions. Activities have, for instance, included readings, lab experiments, music composition, critiquing a video, locating Web resources, and taking a poll. A master schedule for each course dictates these events and expectations in detail, to help ensure that all participating students are able to make meaningful contributions to the class.

Student evaluation is entirely up to the teacher who delivers each course. As part of their professional development, the VHS project helps teachers develop "alternative" evaluation strategies that foster online contributions, collaboration, and student creativity. The project insists that the evaluation methods and criteria be clearly stated as part of each course description.

VHS Courses

With over 200 courses in the current catalog, it is difficult to grasp the range of VHS courses offered. VHS courses are open to students in grades nine through twelve and address specialized content not typically available in most high schools. One powerful motivation for teachers to participate in the project is the opportunity to offer a specialized or advanced ccurse for which there would never be sufficient enrollment in the high school. As a result, the project attracts and encourages some unusual courses. The following sampling of course titles gives a flavor of the resulting range of courses offered. This list represents only 12 of the courses in the 1999-2000 catalog. All the course descriptions can be found online at <http://vhs.concord.org>.

- 101 Ways to Write a Short Story
- A Shakespeare Who-Dun-It
- American Music Heritage - Song and Society
- AP Statistics
- Biology II -- A Second Year Course
- Business in the 21st Century
- Calculus for Business
- Career Awareness for the New Millennium
- Chemistry II
- Computer Graphics on the Internet
- Eastern and Western Thought - A Comparison
- Employability Skills

VHS Costs and Sustainability

Participation in VHS does not alter the basic teaching cost structure of a school. One or more teachers are assigned to a virtual course instead of a "real" one. Because the students enrolled in the virtual courses are outside the school district, this re-assignment reduces the number of students in the district who are taught by district staff. Assuming an average class size of 20, this loss is exactly compensated by the 20 students for each section contributed who are allowed to register in VHS courses. The net result is no change in the number of sections offered and students taught. This "zero sum" feature of the VHS has three important consequences:

Easy expansion. Each school can tailor its level of involvement to its own needs. A school that wants more students enrolled in VHS simply has to offer more sections to the cooperative. Because this decision has no cost impact on other schools, the project as a whole can easily expand to fill whatever need is generated.

Decentralization. Most virtual course projects are highly centralized, offering new courses from a distant center. This model is difficult to finance, reduces the autonomy of the recipient, and threatens school faculty. The VHS model because it is highly decentralized, avoids all these problems. One of the strengths of this national program is that it leaves control in the hands of states, schools, and local teachers and administrators.

Union acceptance. The VHS, on the other hand, has strong union support because it does not alter employment levels and does offer teachers professional development and new employment options.

Participating in the VHS, however, does entail costs. Of course, computers and network access are required. Surprisingly, this is not a major problem for most high schools, since student access to just a few computers can be spread out over time. The major costs to schools are the time required for online professional development and the local site coordinator functions. In addition, the project generates central costs for project coordination, student registration, technical support, server support, and evaluation. One of the major issues being addressed by the project is what these costs are, how they can be minimized, and whether they can be sustained.

It is reasonable to assume that VHS site management will become routine, that the technology will improve, and teacher professional development will require less time. When this happens, the VHS model will be easily and economically duplicated. Rather than simply growing the original VHS, we anticipate that there will be numerous virtual high school cooperatives. Any large district could establish one. Some might be organized around content or language. It is conceivable that highly specialized virtual high schools would be created. If all the virtual high schools adhere to the same quality standards, there can be cross-enrollments between them, increasing the range of courses and student diversity. Small high schools could become more attractive since they are no longer restricted in the courses they offer. It is even possible that the good pedagogy demanded by world-class virtual courses will spread throughout high schools.

"How are we doing?" - VHS Evaluation Efforts

More than two and a half years, three and a half semesters, and dozens of courses into the VHS project, VHS participants have gained unparalleled insight into the many factors that make up a *quality* high school netcourse. In this last year, the project has focussed on the quality of course design and delivery, with the appointment of a national standards board that has established quality standards for netcourses. This board, the NetCourse Evaluation Board, or NCEB, has synthesized the enormous expertise of university-level distance learning experts, state department of education (DoE) curriculum experts, as well as VHS teachers, trainers, administrators, and students, to create a set of netcourse standards by which all VHS courses will be reviewed. In addition, the project will appoint independent "department chairs" (content experts) who will periodically check on the progress of 5-10 netcourses for which they are responsible. The VHS netcourse standards will be adopted not only by VHS, but also by other groups who wish to develop and evaluate high-quality netcourses based on a proven national model.

II. Virtual High School Participants

The best way to begin to understand the enormous impact that VHS is having on American education is to let the VHS participants - students, teachers, site coordinators, and high school administrators - speak for themselves. VHS and all the Challenge Grant projects are designed to serve these students and educators, and they are the people who make these projects truly powerful. In the testimonies that follow, VHS participants explain the impact that the project has had on their lives. They are from different backgrounds and all walks of life. They range from 9th graders to teachers with 30 years' experience. They come from at least eighteen different states and 120 high schools across the country. They live in large urban cities and rural farming communities. What these participants' testimonies have in common is that they point to positive outcomes far greater than the designers of the project ever could have imagined. VHS students talk about the confidence they have gained not only in course subject matter, but also in taking responsibility for their own learning, and using technology and the Internet for real-world applications. Students and teachers talk about the empowerment that comes from gaining access to technology resources, hundreds of courses, and a national community of peers they'd otherwise never have access to.

Teachers talk about the shift to more encompassing teaching strategies that comes from having students of varying ages, backgrounds, and learning abilities together in one class, and about the way perspectives broaden for students who have the opportunity to learn with kids from different parts of the country. All of these lessons and skills will be invaluable to teachers and students as they move into the increasingly more technological and connected world of the 21st century. The following testimonies are grouped into several broad categories that describe the benefits of VHS and the Technology Innovation Challenge Grant program as a whole.

VHS expands horizons and builds communities of learners

"What I find most remarkable about my student's experiences is that they don't feel that they are involved in a distance learning course. They feel that they are members of a virtual high school. The difference is most important. They became part of a national community of learners and explorers. They are excited about their education. The skills and lessons they gain from the VHS program spill over into their regular high school classes. They share their virtual education with fellow students and are able to add unique perspective to regular classroom discussions. They are truly becoming self-disciplined, nationally orientated students. They have moved far beyond the boundaries of our local high school. Ironically, a number of our students have found their virtual courses to be more "real world" than their regular classes. Often the VHS courses are more self-directed, production oriented, less memory based educational experiences. They will take these lessons to college and to life. Any program that adds over one hundred courses to a high school's curriculum, enhances the students' technological skills and links them to students and teachers throughout the United States would have to be considered a great achievement. The fact that Virtual High School has been able to do this while giving the program a very personal community based feel is remarkable. It is an honor to be part of the Virtual High School experience." -- Mark McGrath, VHS site coordinator, Collingswood HS, Collingswood NJ

"..about asynchronous discussion- there are a lot of people who don't really *like* that idea. I emphatically disagree...I love it! I think it works better than face to face discussion, actually. And not necessarily for the reasons that everyone usually says "it gives people time to think about their answers" and "it helps shy students express themselves more easily", etc (although those are advantages....just not the ones that directly apply to ME :P) I like it because everything that everyone wants to say...can get said. It's not like a 'real' conversation where one person says something, and someone else responds, and then someone picks up on a tangent to THAT and you can't really go back the first thread of the conversation....or you could, but you'd have to abandon that new tangent. Either way, you lose out on something. And then there's the fact that we have a complete record of the conversation on hand...which can be useful. I really do think that this 'discussion factor' is one of the BEST things about VHS, and one *WebQuest: A Literary Odyssey*"

I think that VHS is a wonderful experience, I learned not only about the subject - Russia and Soviet Union, but I also learned about myself a lot. I learned how to develop more discipline in my ability to study, I learned more about other teenagers from other vhs classes through vhs students' discussion etc. Surprisingly, I even like my vhs teacher very much! She taught me a lot. Ms Terry Haugen is really a wonderful teacher. It is not easy to do all homework on time but it is great working with her." -- VHS student, *Russian, Soviet, and Post-Soviet Studies*

VHS is a place where kids from all over the country, from all sorts of backgrounds come together and share in learning. Imagine in the future, all high schools being interconnected, and kids from everywhere having the opportunity to experience on a daily basis their peers from communities across the nation. In a nation so vast, that changes so rapidly, whose population is so diverse, we must provide the opportunity to understand each other no matter where we come from, no matter what our cultural heritage. I see Virtual High School as the vehicle for such an opportunity and an incredibly positive use of internet technology." -- John Dye, VHS teacher, *History and the Silver Screen,* Dublin Scioto High School, Dublin OH

"I am very pleased with my course and the experience I have received from it. It has helped me to become more independent and more self-disciplined when it comes to my school work. I enjoyed getting to know my classmates as well as my instructor. I am registered for another class during the spring semester and I can not wait to get started."
-- VHS student, *A Model United Nations Simulation Using the Internet*

"The English AP course I took was one of the most valuable courses I have ever encountered. I believe the success of this course and many other courses depends mainly on the teacher. I enjoyed the course very much. It was a great learning experience. The people I met and the work I did was different from the regular coursework I had been used to. Mrs. West was a dedicated teacher, that's probably why I learned so much." -- VHS student, *AP English: A Web-Based College Level Course in Literature & Composition*

VHS is enabling teachers and students to become confident technology users

"One of our LHS students enrolled in a VHS course would not have graduated this spring without VHS. She had family problems, moved out of the house, worked full time, and had a difficult schedule. VHS was the only class she could fit into this chaos, due to the flexibility of LS. Otherwise, she would have had to attend summer school (at a personal financial cost), and would not have graduated with her class." -- Curt Stedron, VHS teacher, *Screenwriting Fundamentals*, Littleton High School, Littleton CO

"As an English teacher for VHS, I immediately noticed how open students are in their writing. I think they feel more comfortable sharing their thoughts on-line rather than in the traditional classroom. In light of all the focus lately on different high school cliques and some feeling like outsiders, VHS offers students a chance to be a part of something new. Students are not put into a category; I know them through their work. The result is a chance to really share what they think without the fear of being judged." -- Peter Stefanisko, VHS teacher, *Exploring America through its Writers*, Windsor High School, Windsor CA

VHS offers unparalleled professional development opportunities for teachers

"From a teacher's standpoint, it has given me a new adventure and definitely a new challenge. After 26 years of teaching, it has really given me the boost I needed in my teaching career. Sometimes we as teachers become complacent and do the same thing year after year. This type of course makes teaching more exciting and more meaningful. It has really given me more ideas to use in my present classes."-- Joann Collins, VHS teacher, *Exploring the Wonderful World of Multimedia*, Lincoln County High School, Lincolnton GA

VHS greatly increases access to courses and educational resources

"As the Director of Technology at a small rural school district I have found VHS invaluable to our program. With the selection of courses available to us, we can now compete with other local schools both public and private. With only 305 students in both the Jr. and Sr. High, North Brookfield notices every time a student leaves. When asked why they were leaving the response usually includes lack of course selection. With VHS this argument does not have merit. VHS has helped keep our doors open by offering high caliber classes and a teaching staff that is dedicated to educating our young people. We ask that you support VHS as much as possible so that more students have the opportunities that we have had." -- Trevor Bruso, VHS site coordinator, North Brookfield Jr/Sr High School, North Brookfield, MA

"Kalida High School is a small school of only 360 students in grades 7-12 located in the small farming community of Kalida, Ohio. Becoming a part of VHS is one of the greatest things that has happened to the students in recent years. Next year we will have students taking a wide range of courses in a variety of disciplines that was never available before. We will have a teacher teaching a course (Marketing With Probability) that we could not offer here because of a lack of enrollment. -- Dale J. Nienberg, Principal, VHS site coordinator, Kalida High School, Kalida, OH

Rich Environments for Active Learning on the Web: Guidelines and Examples

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Abstract: Rich environments for active learning (REALs) are student-centered learning environments that rely on authentic contexts, collaboration, intentional learning, generative learning, and reflection. They are highly interactive, and depend on a great deal of intellectual probing by the instructor/facilitator and collaboration among students to be successful. Can REALs – typically established in a face-to-face classroom setting – be replicated using distance learning technologies, specifically the World Wide Web? This presentation provides guidelines for creating REALs on the Web, and demonstrates how those guidelines have been applied in a variety of Web-based learning environment (WBLE) contexts.

Rich environments for active learning (REALs) are comprehensive instructional systems that engage students in dynamic, authentic learning activities that increase their control and responsibility over the learning process while they learn problem-solving and collaborative skills and content (Dunlap, 1992; Dunlap & Grabinger, 1992, 1993, 1996; Grabinger & Dunlap, 1995; Grabinger, Dunlap, & Duffield, 1997). REALs are based on a constructivist view of learning, which holds that knowledge is acquired through "a process of subjective construction on the part of the experiencing organism rather than a discovering of ontological reality" (von Glasersfeld, 1979, p. 109). This is then, by definition, a student-centered process. It is also a social process of negotiation, conversation, testing, and challenging (Bauersfeld, 1995; Cobb, 1994). In order to be student-centered, REALs have the following attributes:

1. Promote intentional learning by encouraging the growth of student responsibility, initiative, decision making, and intentional learning;
2. Apply dynamic, generative learning activities that promote high level thinking processes (i.e., analysis, synthesis, problem solving, experimentation, creativity, and examination of topics from multiple perspectives) to help students integrate new and old knowledge and thereby create rich and complex knowledge structures;
3. Utilize authentic learning contexts to promote study and investigation;
4. Encourage collaboration to cultivate an atmosphere supportive of knowledge building communities; and
5. Reinforce reflection by embedding opportunities to reflect on the learning process as well as on the content acquired to promote both learning and metacognitive skill development.

The following are guidelines for creating REALs, and examples of how these guidelines can be realized in a Web-based learning environment (WBLE).

1. Promoting Intentional Learning

REALs support intentional learning. Students engaged in intentional learning are purposeful, effortful, self-regulated, and active learners (Palincsar & Klenk, 1992; Scardamalia & Bereiter, 1985; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989; Scardamalia & Bereiter, 1991; Scardamalia & Bereiter, 1997). REALs attempt to give students more executive control over their learning to enable them to take more ownership, find more relevance, and learn lifelong learning skills. Creating autonomous, lifelong learners, REALs teach students to manage their own learning: identify their learning needs, set learning objectives, select and employ learning strategies, identify and use appropriate resources, and assess their overall process. To be intentional learners, students must identify learning deficiencies and strengths, make and implement plans, develop metacognitive awareness, and revise those plans and actions based on that awareness. To teach for intentional learning means to cultivate those general abilities that make it possible to become independent, lifelong learners (Palincsar, 1990).

Therefore, support for intentional learning begins with fundamental operational behaviors and moves on to learning and metacognitive strategies.

1.1 Support for Transition to an Online Learning Environment

"Students need support and direction to enable them to make the transition from traditional classroom environment to self-directed learning – particularly tools to help them monitor their progress and obtain timely feedback on their activities" (Sherry, 1995, p.352). Hardy and Boaz (1997, p. 1) define student development as the process of preparing "the student for a distance education experience, beyond the technical orientation." This orientation needs to include learning to operate within the online/Web learning environment and refining metacognitive skills. To be successful, students will "need guidance in putting information together, reaching their tutors, and completing and submitting assignments" (Sherry, 1995, p.352).

Regis University does an excellent job of setting the stage for students entering a Web-based learning environment. For each course, students are provided with detailed information regarding getting started in the course; what to expect in the course; how to access course and technical support; what it means to be an online learner and how to be a successful online learner; and how to engage in the course structure, with the course content, and with other students, resources, and the instructor. See: http://www.cudenver.edu/~jdunlap/webnet99/regisoverview.html

1.2 Setting Goals

An important part of operating intentionally is the ability to set realistic and appropriate goals. Since an online/Web learning environment relies heavily on independent initiative and study, these goals need to be meaningful to the student. Part of setting goals is the ability of students to identify what they know and what they do not know. Learning contracts (Knowles, 1975) and action plans are useful tools for providing students structure for goal setting while encouraging independence. For an example of a simple Web-based action plan structure, see: http://www.cudenver.edu/~jdunlap/webnet99/actionplan.html

Problem-based learning (PBL) is an instructional methodology that engages students in formalized, explicit goal setting activities. Some great examples of PBL in a Web environment exist. See: http://www.uchsc.edu/chancllr/offedu/pbl/pbl.html for a Web-based PBL activity on ethical decision-making, and http://education.indiana.edu/~ist/courses/r590/la/critical.html for a Web-based PBL activity on Internet rights and responsibilities in a K-12 environment.

1.3 Metacognitive Awareness

Metacognition is an individual's "knowledge about their own cognitive processes and their ability to control these processes by organizing, monitoring, and modifying them as a function of learning outcomes" (Weinstein & Mayer, 1986). Being aware of one's own cognitive processes involves the utilization of metacognitive skills – "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures that regulate cognitive processes." (Von Wright, 1992, p. 64) Glaser (1984) describes metacognitive skills as: knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn. Metacognitive skills include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviors and strategies when necessary (Ridley, Schutz, Glanz, & Weinstein, 1992).

Reflective journals can be an easy way to help students focus on their metacognitive skills. See the following URLs for simple implementations of reflective journals (more on reflection in section 5 below):

http://transition.alaska.edu/www/SOE/ed626/journals.html

http://www.cudenver.edu/~jdunlap/5990/conferencejournal.htm (student response to reflective journal questions -- http://clem.mscd.edu/~woodleyx/wbi/online.htm)

1.4 Time Management

Distance learning (DL) students must be more focused, manage their time more efficiently, and they must be able to work independently as well as in a group (Hardy & Boaz, 1997). Attrition rates in DL programs are extremely high, variously reported from 50% to 80%. Failure to manage time appropriately is a major cause of this attrition. Students are accustomed to attending classes at regular times, which provides a major time management structure. Online learning environments often leave time for participation up to the student. While faculty need to create an environment that allows students to manage their time and be flexible, they must also not allow so much flexibility that students become frustrated or procrastinate. One way of helping students manage their time in an online learning environment is by providing them with clearly defined activity requirements mapped to a calendar or an assignment matrix. See the following URLs for examples:

http://www.cudenver.edu/~jdunlap/webnet99/calendar.html
http://www.cudenver.edu/~jdunlap/5990/5990syllabus.html#Calendar

2. Applying Dynamic, Generative Learning Activities

REALs involve students in dynamic, generative learning activities. Generative learning activities require students – individually and collaboratively – to be responsible for creating, elaborating, and representing domain knowledge in an organized manner (Cognition and Technology Group at Vanderbilt, 1992; Hannafin, 1992; Scardamalia, Bereiter, McLean, Swallow, and Woodruff, 1989; Scardamalia and Bereiter, 1991). In other words, students are engaged in meaningful and important activities as participants rather than observers. Some generative learning activities provide students with a context or situation requiring them to take action (e.g., a problem that needs to be solved or a case that needs to be analyzed). Other types of generative learning activities require students to determine what it is about a particular content area they wish to know, and then take responsibility for answering their own questions through research and synthesis and representing the acquired knowledge in an organized and accessible way. It is through this process of "generating" knowledge, instead of passively receiving information, that help learners develop structure, strategies, and habit for lifelong learning. Dynamic, generative learning activities, therefore, involve students deeply and constantly in the process of creating solutions to authentic problems through the development and completion of projects. These kinds of learning activities require a shift in the traditional roles of students and instructors. Teachers become facilitators and guides, rather than presenters of knowledge. Students become active investigators, seekers, and problem solvers working purposefully on a challenge.

2.1 Create, Create, and Create

"Dynamic" means active and powerful. Dynamic, generative activities require that students create something meaningful and visible. The Web provides many ways of creating materials and sharing them, either with the class or the worldwide community of practice. Web pages, presentations, papers, or programs are within the means of students to create. The learning activities need to have students create important products that recognize their peripheral participation in a community of practice (Lave & Wenger, 1991).

An example of a Web-based dynamic, generative learning environment is the Web-based Performance Support System (WPSS) (Dunlap & Waterman, 1997; Dunlap, 1998a; Dunlap, 1998b; Dunlap, in press). Similar to electronic performance support systems (EPSS), a WPSS uses the Web to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools to enable high-level job performance. In fact, using the Web to create performance support systems is a perfect fit because the Web is actively used by professionals as a forum for the distribution of current and up-to-date references, instruction, and guidance. By creating a structure that supports individualized and collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making regarding the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. Enabling students to utilize an easy-to-use tool to develop their own WPSS accomplishes two goals:

a. they learn about the domain while they are locating, evaluating (which requires utilization of resources), and organizing resources to support their learning activities; and
b. once the WPSS is completed it can be used to support further learning activities.

In this way, the WPSS not only enables learners to build a learning resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities. For examples of WPSSs in action, see http://www.cudenver.edu/~jdunlap/wpss.html

2.2 Provide Access to Resources

REALs are resource intensive. Learning activities usually include the need to find new information to support positions, accomplish tasks, and create products. In a WBLE, therefore, students should be engaged in activities that require them to use the Web and Internet to conduct research – including, as part of the process, the evaluation of the Web and Internet resources employed during the research process. Web-based Performance Support Systems (WPSS) require students to conduct research on the Web and evaluate the usefulness of the Web resources utilized. See the WPSS discussion and examples above.

3. Utilizing Authentic Learning Contexts

In REALs, learning requires the use of authentic cognitive, psychomotor, and affective skills. An authentic task, activity, or goal provides learning experiences as realistically as possible, taking into consideration the age and maturation level of the students and environmental constraints such as safety and resource availability. Authenticity is an important part of a REAL for three reasons. First, realistic problems hold more relevance to students' needs and experiences because they can relate what they are learning to problems and goals that they see every day (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Pintrich, Marx, & Boyle, 1993). Second, authentic situations that reflect the true nature of problems enable students to develop deeper and richer knowledge structures (Albanese & Mitchell, 1993) leading to a higher likelihood of transfer to novel situations. Finally, authenticity encourages collaboration and negotiation (Johnson & Johnson, 1979; Lowry & Johnson, 1981). Ill-structured, complex problems require a team approach that provides natural opportunities for learners to test and refine their ideas and to help each other understand the content.

3.1 Contextualize Learning

REALs make sure that learning arises from an authentic context. This can be a simulation, case, problem, or task. Contextualized learning is more easily transferred to other situations than decontextualized learning. Regis University uses authentic case studies to drive learning of content and to give focus to student online interaction and collaboration (http://www.cudenver.edu/~jdunlap/webnet99/regiscase.html).

3.2 Make Learning Complex

Authentic learning is complex learning. Over simplified learning is neither authentic nor valuable in a contextualized sense. Simplified situations often provide incorrect understandings that get in the way of future learning and refinements (Spiro & Jehng, 1990). Students exposed to a situation in its natural complexity create richer knowledge structures more useful for future application and learning. Additionally, complex learning contexts encourage more meaningful collaboration. Students do not mind collaborating when it is necessary to achieve a goal that one person could not attain on his or her own. The Curry School of Education at the University of Virginia has developed a number of interactive projects that involve students in authentically complex learning activities such as frog dissection, a multimedia teaching case, and instructional design practitioner cases:

The Interactive Frog Dissection: http://curry.edschool.virginia.edu/go/frog/home.html
Multimedia Teaching Case: http://www.people.Virginia.EDU/~tedcases/
Instructional Design Practitioner Cases: http://curry.edschool.Virginia.EDU/go/ITcases/Terry/

3.3 Increase Meaningfulness and Realism of Activities

Meaningful activities are crucial to REALs for three reasons. First, meaningful activities provide motivation for working in an online learning environment -- the reason for logging on and checking the Web discussion forum, for example. Second, meaningful activities help learners develop knowledge structures that will enable them to transfer their learning to new situations. Meaningfulness provides context that prevents the formation of inert knowledge (Whitehead, 1929). Finally, meaningful activities are seen by students as more realistic -- they are meaningful because they relate somehow to the students' "real world" situation.

The WWW -- through the use and integration of multimedia, video, audio, databases, hypermedia, networks, and e-mail -- allow us to create micro- and virtual worlds that can engage students in meaningful activities that reflect the real world (Collins & Brown, 1986). Examples provided by the Curry School of Education demonstrate how the use of multimedia can enhance the realism of the learning activities being presented (see URLs above). A good Web site for finding virtual tours that can be used for classroom applications is Virtual Tours at http://www.dreamscape.com/frankvad/tours.html. This site lists dozens of museums, exhibits, real time tours, and virtual cameras from around the world. The American Museum of Natural History http://www.amnh.org/ is a rich source of exhibits covering topics from the sciences, social studies, and more. They sponsor online expeditions and Webcasts with scientists and researchers. Other examples of virtual learning activities include:

The Virtual Electron Microscope: http://www.uq.edu.au/nanoworld/online.html
Virtual Tourist: http://www.vtourist.com/

3.4 Encourage Research

REALs require some kind of research activity. One of the major strengths of online learning environments is their access to people, resources, and databases of information. Research, and especially the search process, should be important components of online learning activities. In an online environment, students can more easily come into proximity with communities of practice because the Internet serves as a gateway to a world community of learners and practitioners. Browsers and search engines are vehicles for exploration providing students with critical skills of goal setting, self-directed learning, and testing hypotheses. There are a number of Web-based examples of engaging students in projects that encourage research. See the URLs below for contextualized examples of projects that have research as an important component of meeting the requirements of the larger challenge.

Hosting a Virtual Conference Activity:
http://www.cudenver.edu/~jdunlap/5990/conference.html (See, also, examples of the virtual conferences designed at http://carbon.cudenver.edu/~jdunlap/seminar/ and http://web-education.net/fall98conf/)
Web Site/Unit Evaluation Activity for K-12 Teachers:
http://www.cudenver.edu/~jdunlap/webnet99/siteeval.html

4. Encouraging Collaboration

REALs demand collaboration among students to achieve complex goals. Collaboration acknowledges the social nature of knowledge construction (Bauersfeld, 1995; Cobb, Yackel, & Wood, 1992; Roth, 1990). Through collaborative work, students experience and develop an appreciation for multiple perspectives; they refine their knowledge through argumentation, structured controversy, and the sharing and testing of ideas and perspectives; they gain an appreciation for the value of cooperation and the individual strengths that members of the team bring to the group; and, they are more willing to take on the risk required to tackle complex, ill-structured, authentic problems when they have the support of others in the cooperative group. Therefore, with the support of others in the group, students are more likely to achieve goals they may not have been able to meet on their own. Collaboration also facilitates generative learning.

Web forums and threaded discussions are easy ways to establish an environment for group discussion and collaboration. However, in order to make sure that students are motivated to participate in online discussion and collaboration, it is advisable to have a problem, challenge, case, or project drive and provide a focus for student participation in an online environment. For an example, see: http://www.cudenver.edu/~jdunlap/mess.cgi
More elaborate examples of collaborative learning environments on the Web also exist. A great example is the Learning Through Collaborative Visualization Project (CoVis). CoVis is an online community of thousands of students, over one hundred teachers, and dozens of researchers all working together to find new ways to think about and practice science in the classroom. See: http://www.covis.nwu.edu/

5. Reinforcing Reflection

Self-reflection activities need to be embedded into REALs in order to support the development of metacognitive skills. "Self-reflection implies observing and putting an interpretation on one's own actions, for instance, considering one's own intentions and motives as objects of thought" (Von Wright, 1992, p. 61). Von Wright describes the process of self-reflection as the ability to think about one's self as an intentional subject of personal actions and to consider the consequences and efficacy of those actions. This involves the ability to look at one's self in an objective way and to consider ways of changing to improve performance. Dewey (1933) described the value of reflection as a component of educated thinking. Even though reflective activity is important, it is possible for students to be so caught up in completing a task that they fail to reflect, hindering what they learn. "We can keep students so busy that they rarely have time to think about what they are doing, and they may fail to become aware of their methods and options" (Wheatley, 1992, p. 536). Schön (1983) refers to this as being "in the action" rather than reflecting on the action. If students do not have opportunities to examine their methods and options, they will not develop the metacognitive skills needed for lifelong learning. Therefore, learning activities need to support students in reflecting on their own learning and problem-solving processes, as well as on what they have learned (Schön, 1987).

Engaging students in reflection on the content learned and the learning process itself can be done simply by having a set of questions that students answer throughout a learning activity and once the learning activity is completed Possible reflective questions that address the content and skills learned include:

- How did your prior knowledge affect your approach to the project? Be specific in describing your prior knowledge and how it affected your approach.
- What are three of the most important things that you learned about your topic while working on this project? Why do you consider them important? Be specific.
- Do you believe that your learning from this project represents the breadth of the topic? Why?
- Do you believe that what you were able to learn something about this topic in depth? If so, what is that?
- What did you learn that you could apply to other problems or projects? How?
- What topics did you encounter that you would like to study more? How will you do that learning?

Possible reflective questions that address the learning process include:

- What did you learn about your ability to learn? What new learning/metacognitive skills did you acquire? What did you learn that will make you a more efficient and effective learner on future assignments?
- What kinds of learning problems did you encounter while working on the topic? How did you overcome them? Did anyone else offer useful assistance (who and how)?
- How can you improve as a learner? What are your weaknesses? How will you strengthen them? What will you do differently the next time?
- How has the communication environment affected your learning?
- What could make communicating with the instructor or other students more meaningful?
- What resources did you identify that you will use again? Why?
- When you had trouble finding the information that you needed, what did you do?

Reflective journals can be implemented online very easily using email or Web forms – see:

http://transition.alaska.edu/www/SOE/ed626/journals.html
http://www.cudenver.edu/~jdunlap/5990/conferencejournal.htm

Conclusion

REALs are one way of conceptualizing and applying the attributes of a rich, active learning environment. It helps to break those attributes down into guidelines when determining how to create these types of learning environments for face-to-face or Web-based settings. This paper only presents a few examples of the many excellent implementations of REAL guidelines to Web-based and other online learning environments. Because of the power of the Web -- to provide information in a just-in-time manner, establish immediate access to people and resources, utilize multimedia and hypermedia technologies, provide a forum for communication and collaboration, etc. – it is fairly easy to realize the promise of REALs in an online learning environment.

Note: For references and more examples of REALs on the Web: http://www.cudenver.edu/~jdunlap/webnet99/references.html

Design and Implementation of Interactive, Web Based Courses

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Abstract: Setting up virtual, Web based courses has become very popular among teachers recently. Still, most of them are not familiar with the proper implementation of training material for the Web. This was, at least in parts, also true for the authors of this paper. In this paper a comprehensive course construction concept using novel Web technologies is proposed, featuring simplicity and practicability especially for non technically experienced authors. All vital features like a learning environment, treatment of written basics and interactivity are briefly discussed and introduced with a pilot course.

1. Introduction

Today most universities and an increasing number of big companies all over the world feel the necessity to offer virtual Web based courses to educate their students or employees. Therefore, many teachers and authors of Web based lectures are in search of a complete concept to create virtual and interactive courses from text based scripts and books used for traditional lectures. Beside an excellent mastership of the subject area, there are a lot of additional requirements like programming experience, knowledge of Web technology and so on.

The Institute for Fundamentals and Theory in Electrical Engineering at the Technical University of Graz mainly deals with the numerical calculation of electromagnetic fields and the optimization of electromagnetic devices. Up to now, the use of Web technology was more or less reduced to the application of a browser. But the change of teaching and learning paradigms, the need for spatial and temporal independence for local students as well as "far distance" availability for non local and worldwide spread students, make it necessary to offer virtual courses. There have been some initial experiments with online electromagnetic field calculation examples using the CGI and TCL scripts to remotely control a Finite Element Software package and its Pre- and Postprocessors [Preis 1997]. Nevertheless, there has been neither a real concept how a virtual course should be designed, nor the technical know how to implement it, which, however, seems to be a common problem. This paper proposes a way to overcome these difficulties at the example of a highly interactive Web based course of the lecture "Optimization in Electrical Engineering". Although the implemented course comes from the field of engineering, many of the suggested solutions, which had to be totally programmed by the authors, can be adapted for other fields. This is even more applicable as upcoming tools will virtually simplify the process of treating dynamic contents. Also users, who are no experts in Web technology, will be able to use these tools.

Basically, the task should be divided into two major parts: The Web based learning environment, which builds up the backbone of any good course and the handling of the contents. The content itself is again divided in two elements:

- Theory and Basics
- Examples and Interaction

Nearly of same importance is the evaluation of the students advancement and their self assessment which accompanies and completes a course.

2. The Learning System

The quality and comprehensibility of the course content is definitely one of the most important parts when teaching a certain topic with the support of the Web. Unfortunately the course pages can not exist alone, at least some sort of navigation like leafing forwards and backwards, a table of contents etc. has to be provided. Also it would be nice if the learning and teaching process is supported by communication and collaboration facilities between distant students and teachers and among students themselves to utilize the possibilities of the Internet.
Of course it is desirable that authors do not have to invest much time and work to accomplish this, in contrast routine tasks like interlinking pages should be performed automatically and it should really be easy to configure an environment that optimally embeds courses, so that authors can fully concentrate on the actual content creation process. To provide all this is exactly the purpose of a learning and training/teaching system!
After evaluating a few available systems [WBT Systems 1999] [WebCT 1999] we decided to use GENTLE (GEneral Networked Training and Learning System [Dietinger 1998] [Dietinger 1997]) which is a research project currently under development at IICM (Institute for Information Processing and Computer supported new Media at the Technical University of Graz).

GENTLE is based on a Hyperwave Information Server [Maurer 1996] and only requires a JavaScript capable browser like Netscape 4.x or Internet Explorer 4.x (or greater) on the client side because the whole user interface is implemented using HTML, DHTML and JavaScript. The working prototype is also called Hyperwave Training Space. The WBT system currently distinguishes four different types of users and provides different features and functionality for them. These types are participating students, teaching staff like trainer and tutors, courseware authors and system administrators. Users can also belong to several types at the same time (e.g. an administrator could be a student at one course and a teacher and author at a different one). Within the environment various so called *rooms* separate different scenarios and tools provide additional functionality to the users.

Typically users enter the environment through the *registration desk* where they can register for a personal account, read the introduction and an overview to the system or look at the list of available courses. After the users have registered they will get a unique login name and a private space on the courseware server, which is called *study room* and can be entered upon successful identification. The study room is the main working place and also provides access to all other rooms. Here students will get a list of suggested courses (depending on the users' profiles), may enter enrolled or review already finished courses. Teachers and authors may also create new courses by using a tool called *course wizard* which upon activation asks a few questions concerning the lecture (like aim of the course, prerequisites required to master it, time and place of live lectures if appropriate, tutors etc.) and automatically creates a course skeleton and some introductory HTML pages. The course content itself can easily be added either by using the Web browser or via drag and drop by using the *Hyperwave Neighborhood*, a Windows 9x/NT Explorer extension. Access to the *administration office* is only granted to teachers, authors and administrators and is used to maintain user accounts, teams, courses and modify system settings. Of course not all functions are available to all three user types in the same manner, e.g. teachers can suggest or assign their own courses to different students but may not remove other courses or delete user accounts. Although students do not have access to the administration office they can directly change their own profile by altering the settings of the electronic business card. Most parts of the business card like photo of the student, the name and other personal data may be made public and can be viewed by other members of the system whenever they click on a visible user name. This has the positive and important effect that a personalized virtual community can be created because users can imagine how other users look like or what their hobbies are, which simplifies teamworking and collaborating. The study room also contains a personal Web space where the students can develop their own projects or work together in shared areas.

If students select one of the listed courses in their private study rooms they will be moved to the *class room* of the specific course. The class room provides access to the course content, which is dynamically interlinked (including e. g. the creation of a table of contents) and adaptively presented, which means that it can vary depending on the students preferences. Furthermore the classroom offers different tools for communication like a messaging system which can be synchronized with Internet mail, a discussion forum with sophisticated functionality that surpasses e.g. Usenet News, and personalized and typed annotations. Annotations can be directly attached to a certain area within the HTML content page (or to the whole page if it is non HTML) just by selecting the text area and adding the note. Afterwards an icon indicating the annotation and heading the selected area will be visible only for the author of the note, or for a team or the public depending on the assigned access rights. Annotations can also contain attachments and a certain type like remark, question, answer and supporting argument. If a student poses a question note, the tutors of the course will be notified automatically by the messaging system so that they can answer the question as soon as possible. After doing that, the student that asked the question will also get a notification that it has now been answered. To minimize question answer dialogs and thus supervising effort the system supports various sophisticated searching techniques like fulltext query within every part of the system and a course specific section for storing background material called the *background library*. This should improve the chance that students can find an answer to their questions on their own.

This just describes the current state of the system at the time of writing, however as we know huge enhancements like more tools that automate routine tasks, more support for collaboration and personalization and also a hybrid version that combines the advantages of online and offline learning and teaching are planned.

3. The Theoretical Part of the Lecture

The theoretical part of a technically oriented lecture in general consists of written text, figures, equations, tables and references. Standard Multimedia contents like mpeg videos or spoken audio files can easily be added without special plug-ins – which was a major requirement for our course. Nevertheless, the preparation of high quality multimedia content often exceeds many authors capabilities.
But even generating a single, multipage document caused great problems at the time this project started. So far, no proper HTML editor is known to cope with automated page numbering, figure numbering, equation and table numbering as well as chapter and section numbering and header and footer insertion which are standard features of nearly any text editing systems like WinWord or Latex. HTML editors like MS FrontPage98 or Netscape Composer were and still are supporting single pages only and deal with multiple pages in a unsatisfying way. To overcome this problem a couple of small utilities were developed using Perl programming language following the model of the Latex text editing system [Wall 1996] [Lamport 1994]. Each figure, table and equation is assigned a reference name in the plain HTML text which is processed and the respective numbering is inserted in the correct way. Headers and footers and any desired HTML parts can be inserted at marked positions in a similar way.

To ensure reusability of individual course chapters within other courses, a modular concept was adopted. Each single chapter is treated as an independent module with few hyperlinks to other chapters and no links to the Internet. Modules can be detached from one course and easily reused within another one by deactivating or reorganizing the hyperlinks. Instead of a flood of links within course pages, advanced searching and browsing facilities and additional reference links are provided via the background library.
But even inside a single chapter one can easily get lost somewhere in the hyperspace, between the current page and some auxiliary pages which are referred to and displayed [Dietinger 1997]. The authors have overcome this problem by keeping the current page always visible. Figures, tables, equations and even references which are not part of the actual viewed hypertext page are overlaid in extra windows on demand and closed automatically when the user browses to the next main page. This supports the generation of short and efficient pages.

Another feature, well known from offline education software but not easily available for Web based systems until Dynamic HTML, is a series of figures with a corresponding explanation successively displayed at the same location of the main page. Series of pictures with correlated text and little animations were implemented in Java Script using Cascading Style Sheet (CSS) features. Applying DHTML, figures and text can be separated and text remains text in contrast to "slideshow" figure/explanation series. Animations can be easily inserted. It has turned out that this is a good way that even complex subjects can be understood more easily.

Another special element is used to visualize program flowcharts or more complex (sequential or parallel) processes. An image map is controlling accordant images and illustrations with DHTML which may again be combined with animations. Applying such elements has the positive effect, that normally inactive text is enhanced with some interactivity. The students are called to click the image maps and serials, watch the animations and changing figures according to their learning style and speed, which is much more challenging than plain text. Java Script program modules can easily be reused in other pages or courses with only few adaptations required.

4. The Interactive Part of the Lecture

There are two philosophies to allow interactivity for online courses:

- the Client Solution
- the Server Solution.

Examples executed at the client computer, mostly implemented as Java Applets, do not need an additional server and could be also used in offline mode (e.g. on a CD-ROM edition). Many authors strenuously realize sophisticated examples as Applet programs, but really complex examples like Finite Element calculations are absolutely impracticable with a client solution. Server side run programs are much more powerful, but the interface is hard to implement, and an additional online, administrated server is needed to provide full performance for both the learning environment and the examples. Therefore, we use a combination and benefit from both methods.

Simple numerical and theoretical examples are realized as client applications. For example, the student is asked to derive analytical formulas and the result appears directly within the page without a Hyperlink to click. This is the same method often used in text books, where the solution of examples could be looked up in the back of the book, but much more comfortable and faster. Simple numerical examples may either use the click and show system which is also applicable for ordinary text questions or the students are asked to enter their solutions which are validated by the system. The students receive either a confirmation that their results are correct or an invitation to redo the calculation with a text depending on the number of trials already performed. The design and implementation of these objects is fast, efficient and technically not too difficult, in particular because there already exists a growing number of commercial applications supporting such DHTML objects.

To deal with more complex examples, we have been using a server side solution. Like in modern class room lectures where computer applications are often used to support and improve the traditional lessons, Web courses can make use of these applications if they can be remotely controlled. Application programs in our implementation are MATLAB [Mathworks 1999], Fortran optimization routines and a Finite Element Package solving electromagnetic field problems. Using these software the design of very complex, real life simulations and examples is mainly reduced to conceive the example itself while its implementation is strongly supported by the program packages. The functional elements for user input are standard HTML forms and input data are transmitted using the "Post" method. Input data for training examples are mostly parameters – in the optimization case strategy parameters and problem parameters, formulas, sometimes instructions – and the output data are pictures, text, numerical data and animations packed into HTML pages. Online calculated animations are provided as image frames and displayed using an appropriate Java Applet.
The amount of data transfer over the Internet can be kept fairly low this way, all calculation and generation of HTML output is done on the server. The performance bottleneck of the whole chain is the application server. If there are too many students to be served at a time a splitting to multiple application servers can be done [Kovács 1998]. We have experience with about 150 students doing extensive Finite Element calculations within a month which was done with one server in a satisfying way. Since the calculation period of our examples lasts from some seconds up to some minutes a pure CGI compliant interface using Perl scripting language is sufficient. A simple, but relatively easy to implement form of remote controlling is possible if the application supports a scripting language and the transfer data is passed via files. Therefore our data transfer between applications and CGI is mostly handled by files and DDE (Dynamic Data Exchange), but it could also be worked out by another direct link between server programs and Web server (NSAPI, ISAPI) or with FastCGI, depending on the remotely controlled application [Göschka 1998]. A semaphor concept using file locking guarantees error-free concurrent multi-user service of the application server. The whole system structure can be seen in [Fig. 1].

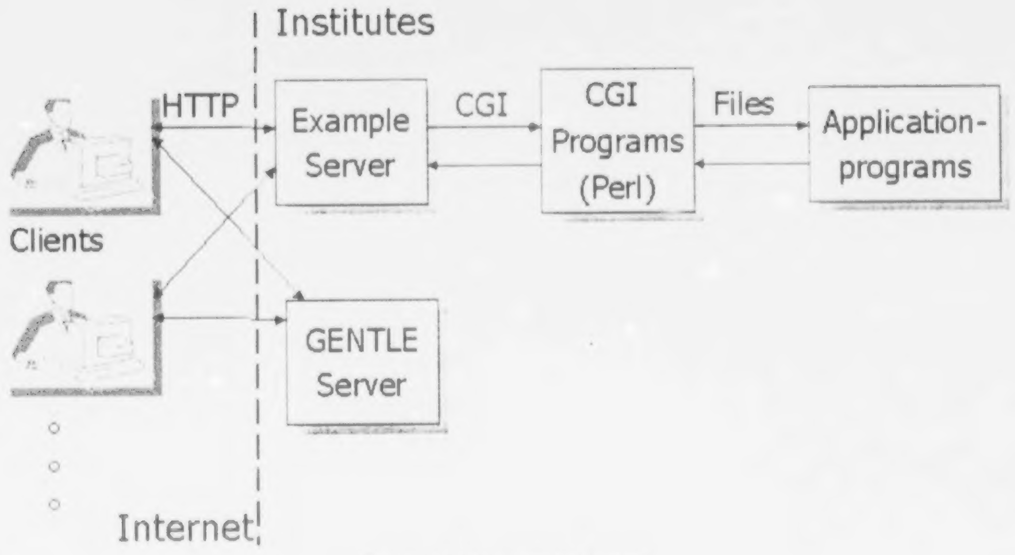

Figure 1: The Learning System

5. Evaluation of the Student's Progress

Beside the most obvious form for evaluation in Web based courses, the multiple choice quiz, written statements, reports or exams with open questions are other possible options. Either an automatic grading (easy to gain with multiple choice quizzes) or manual assessment may be used by the teacher. At the time of writing of this paper no evaluation concepts were implemented in the GENTLE learning environment. Despite a rather high level of personal engagement, we decided to implement question forms with open questions and questions to be answered by a statement which are both graded manually. Although designed for self assessment, the objects described in the interaction section are very well suited for test and evaluation purposes. A number of questions can be based on a server based example module which has to be used by the student to answer the question. For example, the students are asked to run an optimization problem with different optimization strategies and interpret the results. Answers to the questions are automatically formatted and prepared for database access by CGI scripts. To ensure objectivity, examinations are held at fixed times in computer rooms with a person in charge.

6. Conclusions and Further Development

All necessary parts to successfully create a Web based course have been briefly discussed in this paper. The GENTLE system fulfills all requirements for an excellent courseware and the further development of the software benefits from persistent feedback of the course authors. Nevertheless also other courseware systems like WebCT or Topclass are suitable choices [WBT Systems 1999] [WebCT 1999].

The "first time" development of the quoted Java Scripts, HTML modules, Perl programs, CGI programs etc. is expendable and time consuming. Once available the modules can be adopted for other courses very quickly with few adaptations. Up to now the time consuming implementation of proposals has been reserved to technically experienced people with programming skills, but forthcoming application software like Dreamweaver2 will ease the task significantly [Macromedia 1999]. The most difficult job remaining will be the adaptation of server based software especially because no practicable solutions for that can be expected in the near future.

Currently, there is much work in progress to apply solutions for interactive tutorials for Finite Element Software applications also in offline mode. In the future we plan to transfer many more lectures from the traditional way of teaching to the virtual one with a high grade of interactivity. Concurrently, further progress takes place in the development of the GENTLE virtual learning system and new features like standardized evaluation methods will be added.

7. References

[Preis 1997] Preis K., Bárdi I., Biró O., Hoschek R. and M. Mayr. A Virtual Electromagnetic Laboratory for the Classroom and the WWW, *IEEE Transactions on Magnetics*, Vol. 33, No. 2, pp. 1990 – 1993, March 1997

[WBT Systems 1999] TopClass from WBT Systems, http://www.wbtsystems.com/

[WebCT 1999] WebCT Homepage, http://homebrew.cs.ubc.ca/webct/webct.html

[Dietinger 1998] Dietinger T., Maurer H.. GENTLE – General Network Training an Learning Environment, Proc. of *ED-MEDIA98/ED-TELECOM98*, ISBN: 1-880094-30-4, pp. 274 - 280, Freiburg, Germany, June 1998, http://wbt.iicm.edu/gentle/papers/edmedia98.pdf

[Dietinger 1997] Dietinger T., Maurer H.. How Modern WWW Systems Support Teaching and Learning. Proc. of *International Conference on Computers in Education (ICCE) 1997* (Ed. Z. Halim, T. Ottmann, Z. Razak), Kuching, Sarawak Malaysia, December 2-6, 1997, pp. 37 – 51., http://wbt.iicm.edu/gentle/papers/icce97.pdf

[Maurer 1996] Maurer, H. (1996). *HyperWave: The Next Generation Web Solution*, Addison Wesley Pub.Co., UK

[Wall 1996] Wall L., Christiansen T., Schwartz R. L., *Programming Perl, 2nd edition*, O'Reilly & Associates, Inc., 1996, http://www.perl.com/pace/pub

[Lamport 1994] Leslie Lamport. *Latex – A Document Preparation System*, Addison-Wesley Co. Inc., Reading, MA, 2. ed, 1994

[Mathworks 1999] The Mathworks, Inc., 24 Prime Park Way Natick, MA 01760-1500 USA, http://www.mathworks.com

[Kovács 1998] Kovács F., Szitnyai G., Monostori K., Charaf H., Vajk I.. Teaching Control Theory Interactively, Proc. of the *15. IFIP World Computer Congress, 1998*, Aug. 31 – Sep. 4, (ed. Gordon Davies), Vienna/Austria and Budapest/Hungary, pp. 579 - 588

[Göschka 1998] Göschka K.M., Riedling E.. Web Access to Interactive Database Training: New Approaches to Distance Laboratory Work at the Vienna University of Technology, Proc. of the *15. IFIP World Computer Congress, 1998*, Aug. 31 – Sep. 4, (ed. Gordon Davies), Vienna/Austria and Budapest/Hungary, pp. 349 - 360

[Macromedia 1999] Macromedia Dreamweaver, Homepage, http://www.macromedia.com/

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Creating Websites on CD-ROM for Educational Use

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Abstract: The BURKS project produces non-profit CD-ROMs for students of Computer Science. Now in its fourth edition, BURKS is a set of two CD-ROMs which incorporates a pre-installed copy of Netscape Navigator and which functions as a single self-contained website. This paper describes the techniques used to implement the CD-ROM, which include methods for avoiding having to install any software on the target system, avoiding interfering with any existing browser installation, and managing disk changing to make the two disks act as a single website.

1. Introduction.

Although there are many useful resources for Computer Science students available on the Internet, it is wasteful to expect students to find and download individual copies for their own use. More importantly, students need access to these same resources to be able to work at home, and although it is now the norm for our students to own PCs with CD-ROM drives, off-campus Internet access is at present much less widespread. This is largely due to the high cost of telephone services in the UK where local calls are charged by the minute in addition to line rental charges. BURKS, the Brighton University Resource Kit for Students [English 1998], was initiated in 1996 as a non-profit, zero-budget project to provide Computer Science students with a selection of useful resources from the Internet on CD-ROM. Four editions have now been produced in August each year since 1996, with the fourth edition appearing in August 1999. Targeted at IBM PCs running Microsoft Windows 3.1 or later, it is now a 'recommended text' on several courses worldwide (e.g. [van Scoy 1998]).

BURKS is essentially a local mirror on CD-ROM of a large selection of resources available elsewhere on the Internet, including tutorials, reference manuals, specifications, published papers, textbooks, compilers and other software, and a dictionary of computing. This is organised as a website, using HTML as a common language for indexing the collection as well as the documents it contains. Although it is completely self-contained, the use of HTML as a common format also allows the CD to provide links to external resources to cater for users who do have access to the web. This also makes it possible to provide the entire collection online at the BURKS website, *http://burks.brighton.ac.uk/*.

Students entering our courses are usually complete novices, and the intention of the project is to cater for the needs of such students. This means that ideally it should not be necessary to install any software before the CD can be used, and that installing software packages from the CD (compilers etc.) should not require any special skills or knowledge on the part of the student. In addition, it should not be necessary for a user to have a web browser already installed on their system. The solution adopted by BURKS is to use an integrated web browser which runs directly from the CD with no separate installation step. For systems which already have a web browser installed (a fairly rare situation in 1996 but now a commonplace), the CD is carefully designed so that the preinstalled browser will not affect the configuration of the user's existing browser, and thus it is usable on any system with or without an existing browser.

Supplying a pre-installed web browser on the CD has some additional advantages:

- It removes problems due to browser incompatibilities, such as support for frames and tables, rendering differences, and JavaScript support
- The browser can be preconfigured with settings such as a specific home page and a set of helper applications for an assortment of file types provided on the CD.

This paper describes the techniques which have been used to implement the BURKS series of CDs.

2. The First Edition (1996).

The first edition of BURKS was essentially a pilot project to assess the viability of building a self-contained website on a CD. Due to the timescales involved, the only web browser that the author could obtain permission to use was Cello, a free browser from the Legal Information Institute at Cornell University. The main disadvantage of Cello is its lack of support for all but the most basic HTML constructs. However, it could be run directly from the CD, with only two files (`CELLO.INI`, the initialisation file, and `CELLO.STY`, the style file) needing to be copied to the user's Windows directory. This would cause problems if the user already had a copy of Cello as these two files would override any existing settings, but the risk of this was considered to be extremely small.

The initialisation file `CELLO.INI` needed to be located on the user's hard disk rather than on the CD so that options such as the default window size and position could be altered by the user, either in the user's Windows directory or in a directory specified by an environment variable. `CELLO.INI` specifies a number of settings, including the following:

- The URL of the home page to be displayed at startup, or when the 'Home' command is selected;
- The location of the style file;
- The window geometry (size and position);
- The applications associated with particular file extensions.

The Cello executable and other required tools were held in a subdirectory on the CD, together with default versions of the `CELLO.INI` and `CELLO.STY` files. A startup program called `BURKS.EXE` was stored in the root directory on the CD which was responsible for the following actions:

- Copying the default versions of `CELLO.INI` and `CELLO.STY` to the user's Windows directory if they did not already exist;
- Setting the URL for the home page in `CELLO.INI` to refer to the main index file on the CD;
- Setting the desired applications to be invoked for particular file extensions in `CELLO.INI`;
- Launching the Cello executable.

Unlike Unix systems, an MS-DOS or Windows executable is able to determine its full pathname. This allows a program on a CD to discover the drive letter for the corresponding CD drive, which can then be used to build full pathnames for other executables on the same CD as well as URLs for the HTML documents it contains.

BURKS uses the autorun feature for CDs introduced in Windows 95, so that inserting the disk on a Windows 95 system will launch the startup application automatically and thus launch a web browser to display the main index page on the CD. No separate installation step is necessary.

The file associations in the `CELLO.INI` file specified that files with the extensions .ZIP and .EXE were to be associated with a helper application provided on the CD, and files with the extensions .I, .S or .GZ were to be associated with another helper application. ZIP and EXE files are the two formats used for software packages on the CD; ZIP files are compressed archives and EXE files are self-extracting executable archives. I, S and GZ are the file extensions used for the installation disks for the copy of Linux (the Slackware distribution) that was included on this version of the CD.

When a URL with one of these extensions is selected, Cello launches the specified application and passes it the full URL as a command-line parameter. The first helper application (that used with ZIP and EXE files) copies the file to a user-nominated local directory on the user's hard disk and then allows the user to unzip the file or execute it, depending on whether the file has a ZIP or EXE extension. The copying step caters for the fact that the file is not necessarily one supplied on the CD; it might be one found at a remote site which will require downloading before it can be processed. The other helper application will treat the file as a raw disk image; it will copy the file directly to a floppy disk, thus simplifying the process of creating Linux boot disks for novices.

3. The Second Edition (1997).

The first edition was released in limited quantities as a proof-of-concept prototype. The smallest possible production run was 250 copies, which was more than could realistically be sold to students at Brighton. The size of the print run meant that the CD was priced at £7.00 per copy to cover manufacturing and distribution costs. Copies were distributed to other institutions and review copies were sent to a number of publications to gauge interest elsewhere. Copies were also distributed to industrial delegates at a one day conference in London in November 1996 which was sponsored by Ada UK, and to the author's initial surprise it proved extremely popular. This is apparently because Internet access in industry is often more restricted than it is in academia, and few people have the luxury of being able to spend hours scouring the net for potentially useful material. A further 250 copies were therefore printed in January 1997 to accommodate this demand.

As a consequence of the popularity of the first edition, GEC-Marconi and Pavilion Internet agreed to fund the production of a second edition in the summer of 1997. The second edition was distributed primarily by the University of Brighton, but also by the George Washington University in Washington DC to cater for orders from the USA and Canada. An initial print run of 3,500 copies was produced, which allowed the price to be reduced from £7.00 to £3.00 each ($5.00 in North America). About 2,000 free copies were distributed to educational institutions throughout the UK, and over 11,000 copies were distributed altogether. The BURKS website (*http://burks.brighton.ac.uk*) also registered an average of about 20,000 hits per week from over 100 different countries.

The major difference between the first and second editions was that the second edition used Netscape Navigator 3.01, by permission of the Netscape Communications Corporation. This is a considerably more complex piece of software than Cello, with support for frames, tables, JavaScript, and many other features that Cello lacked. It was also more likely that users would already have a copy of some Netscape browser installed on their system than it would be for Cello. Using Netscape Navigator made it necessary to devise a method to pre-install the browser so that it would have as little impact on the target system as Cello did in the first edition.

Experiments showed that installing Netscape Navigator from the standard distribution copied several megabytes of shared libraries into the Windows directory of the host system. However, as the first place Windows looks for shared libraries in the same directory as the executable file which is trying to access them, the need to copy shared libraries could be eliminated by identifying the files in question and putting copies in the same CD subdirectory as the main Netscape executable. They would therefore be found on the CD regardless of whether they were already installed in the Windows directory tree.

The next problem was identifying the Netscape initialisation file (`NETSCAPE.INI`). This was slightly more problematical than in the case of Cello, as the chances of a user having a copy of Netscape Navigator are much higher than for Cello. For 16-bit versions of Windows, if the initialisation file is not in the Windows directory, Netscape Navigator uses an entry in the central Windows initialisation file (`WIN.INI`) to locate it. 32-bit versions of Windows use the central Windows registry for all initialisation details and have no separate `NETSCAPE.INI` file. Any existing copy of Netscape Navigator would be seriously affected if the initialisation file were changed by the copy on the CD. However, Netscape Navigator inherited several command-line options from its predecessor, NCSA Mosaic. One of these options was a *-i* switch to identify the location of the initialisation file, which is still supported by 16-bit versions of Netscape prior to version 4. (This switch was undocumented prior to version 4, but although it is now documented for version 4 it no longer works as advertised!)

In summary, this scheme requires all the shared libraries to be placed in the same directory on the CD as `NETSCAPE.EXE`, and the startup application must copy a default version of `NETSCAPE.INI` to a directory on the target system and modify it as described above for Cello before finally launching Netscape Navigator using a command line like this:

```
X:\TOOLS\NETSCAPE.EXE -i C:\WINDOWS\BURKS\NETSCAPE.INI
```

where `X:\TOOLS` is the directory on the CD which contains `NETSCAPE.EXE`, and `C:\WINDOWS\BURKS` is the directory to which `NETSCAPE.INI` was copied. Netscape Navigator then starts up using the specified initialisation file (which has been placed in a dedicated subdirectory of the user's Windows directory tree for the sake of convenience).

The scheme described above has the advantage that no executables or shared libraries need to be copied to the user's hard disk, and that any initialisation information is kept in a special initialisation file on the target system which is unconnected with any other installed browsers. This means that the impact on the user's hard disk is minimal, and existing browser installations are not affected.

4. The Third Edition (1998).

The third edition was released in August 1998 with sponsorship from GEC-Marconi and ROCC Computers. Since the second edition comprised a full 650M of material, there was no space left for expansion, and so for the third edition it was necessary to move to a dual CD edition. This entailed a number of significant changes to the design of the system so as to preserve the appearance of a single connected website, while still allowing the two CDs to be installed for public use as a single entity on the BURKS website. The easiest way to deal with this was to put the software archives (the ZIP and EXE files) on the second disk, leaving all the HTML documentation and the Linux distribution on the first disk. This meant that the 650M of the second edition was split into two roughly equal halves of about 300M each. Both disks were provided with identical copies of the browser and index files, so that either disk could be inserted initially. The main problem was the need to prompt the user to change disks if a resource on the other disk was accessed. As an extra complication, Netscape Navigator reports an error if a local URL refers to a file which does not exist or is empty (zero bytes in size), so there must be a complete set of corresponding non-empty files on both disks.

The solution adopted was to use the URL syntax for document subsections [Berners-Lee et al. 1994] (e.g. `http://site.org/document.html#subsection`). Experiments show that when a helper application is invoked, Netscape copies the target URL into a local file, and then passes the name of the local file (usually something apparently meaningless like `X5QP3STV.ZIP`) to the helper application. At the same time, a temporary entry is made in the initialisation file under the heading 'Temporary File URL Resolution' which maps the local filename to the original URL. All that is needed is a reference to a file (called `INSTALL.SW` in the case of BURKS 3) that will be guaranteed to exist in every software-related directory on both disks, and together with a subsection reference this will result in the initialisation file containing a line mapping the filename to a complete URL, e.g. a line like this:

```
c:\temp\x5qp3stv.sw = file:///x:/burks/software/langs/install.sw#2:gnat307d.zip
```

The helper application will then be passed the name '`c:\temp\x5qp3stv.sw`' as a command line parameter, and from the entry in the initialisation file it can extract the directory name (`x:/burks/software/langs`), disk number (`2`) and the name of the file (`gnat307d.zip`) that needs to be installed. The inclusion of the disk number allows this scheme to be extended to work with any number of disks. The file `INSTALL.SW` will have been copied to `c:\temp\x5qp3stv.sw` from the directory `x:\burks\software\langs`, and the only thing required by Netscape Navigator to make the trick work is that `INSTALL.SW` should exist and be non-empty.

As one of the project requirements is that the CD be available online, the `INSTALL.SW` files need to contain genuine HTML content (and the BURKS webserver needs to be configured to serve up `*.SW` files as HTML files) so that external visitors will see something worth looking at when they reference the online equivalent of the URL above:

```
http://burks.brighton.ac.uk/burks/software/langs/install.sw#2:gnat307d.zip
```

Since web browsers ignore white space in HTML text, a little judicious formatting allows the installation instructions to be expressed using valid HTML syntax, and this formatting is easily accomplished by a Perl script which generates the index files from the master file list during the CD production process. Here is an example:

```
<DT><A NAME="2:gnat307d.zip" HREF="gnat307d.zip"
>gnat307d.zip</A><DD>
<B>Directions:</B>
Unzip into an empty directory, then
run SETUP.EXE
<BR><B>Notes:</B>
 Be careful: if you have GCC installed
 anywhere else on your system, make
 sure that your path is set up so that
 you pick up the correct version. Using
 the wrong version by mistake will usually
 crash your system.
```

Despite the eccentric layout, this is valid HTML [Raggett 1997]. When viewed online at the BURKS website, a standard browser will display it like this:

gnat307d.zip

Directions: Unzip into an empty directory, then run SETUP.EXE

Notes: Be careful: if you have GCC installed anywhere else on your system, make sure that your path is set up so that you pick up the correct version. Using the wrong version by mistake will usually crash your system.

When the same URL is referenced from the CD, the associated helper application interprets the HTML text shown above as an installation script where the first character of each line determines its role. The file name is given on a line which begins with '>'. Lines beginning with '<' are ignored; lines beginning with 'U' indicate that the file must be unzipped, lines beginning with 'r' specify the name of a setup utility (`SETUP.EXE`) to be executed, and so on. Lines beginning with a space (the last six lines in the example above) are displayed as installation notes by the helper application to provide additional guidance for the user.

The helper application asks the user to remove disk 1 and insert disk 2. Users can specify an alternative drive letter for disk 2 if they have multiple drives; the helper application records the drive letter for each disk in the Netscape initialisation file. It then parses the installation instructions in the `INSTALL.SW` file that has been copied to the hard disk and installs the software as instructed, and finally asks the user to re-insert the original disk if the same drive is being used for both disks. The helper application checks for the presence of a file called `README.1` or `README.2` in the root directory of the CD to identify which disk is currently loaded.

To maintain the illusion of a single shared website, despite it being split across multiple CDs, it is possible to insert either of the two disks to start with. Both disks contain identical copies of Netscape Navigator and associated software, as well as copies of all the top-level indexes. However, on the second disk the opening page of each document from the first disk is replaced by a stub page containing some simple JavaScript which displays a blank page together with a JavaScript-generated dialog prompting the user to remove disk 2 and insert disk 1. If the OK button is pressed, the current page will be reloaded; if disk 1 has been inserted, this will now be the opening page of the requested document. If the Cancel button is pressed, the browser will go back to the previously displayed page, which will be the index page which referenced the missing document.

5. Summary and Conclusions.

The use of a web browser which is pre-installed on a CD has a number of benefits:

- It is unnecessary to rely on the user having a web browser already installed
- The material on the CD can be targeted at the specific browser supplied , thus avoiding problems with HTML and JavaScript incompatibilities between browsers
- The browser can be tailored to use a specific home page and a specific set of plug-ins, helper applications and so on.

Since CD-ROMs can hold up to 650M of material each, it is important to provide comprehensive indexes to allow specific items to be located in the mass of material available. HTML is a convenient means of indexing which can be processed by standard web browsers, eliminating the need for any special-purpose index processing software. It also allows links to external sites to be provided. (An important requirement not covered in this paper is the need for tools to automate the generation of the HTML index files on the CD.)

There are some limitations: since the browser is not being used in conjunction with an active server, the scope for automation is limited to JavaScript, helper applications and plugins. Another problem is that 16-bit versions of Netscape have been used, both to support users of 16-bit versions of Windows and to use the *-i* switch to specify the location of the initialisation file. These versions do not support long file names or Java applets. 16-bit versions of Netscape version 4 browsers support Java, but have complications which prevent their use as described above (the *-i* switch, although documented, does not work correctly, and there are also some issues related to the use of the registry).

As this paper shows, it is a fairly simple matter to produce a CD-ROM which behaves as a self-contained website and which has a minimal impact on the user's system, although there were a number of interesting problems to be solved along the way. The BURKS project has been successfully producing such CDs for the past four years, and the current version is a 2 CD set which still behaves as a coherent integrated website. It is hoped that this paper will stimulate others to produce similar products, and indeed the author has received a number of queries from others who wish to produce similar products for subjects other than computer science. Developments such as DVD [ECMA 1997], XML [Bray et al. 1998] and increased Internet accessibility will undoubtedly require the product to continue to evolve, or might even eliminate the need for it altogether, but as long as the demand persists the BURKS project will continue to investigate better ways of providing large amounts of material for students at the lowest possible price using whatever technology is appropriate.

References.

[Berners-Lee et al. 1994] Berners-Lee, T., Masinter, L. & McCahill, M. (1994). Uniform Resource Locators. RFC 1738, *ftp://ds.internic.net/rfc/rfc1738.txt*

[Bray et al. 1998] Bray, T., Paoli, J. and Sperberg-McQueen, C.M. (1998) Extensible Markup Language 1.0. World-Wide Web Consortium, *http://www.w3.org/TR/1998/REC-xml-19980210.html*

[ECMA 1997] European Computer Manufacturers Association (1997). 120 mm DVD Read-Only Disk. Standard ECMA-267.

[English 1998] English, J. (1998). BURKS: A Resource Kit for Software Engineering Students. *Software Engineering Education Symposium, 1998*, Poznan, Poland. 70-76

[Raggett 1997] Raggett, D. (1997). HTML 3.2 Reference Specification. World-Wide Web Consortium, *http://www.w3.org/TR/REC-html32.html*

[van Scoy 1998] van Scoy, F. (1998). Using the BURKS 2 CD-ROM in a Principles of Programming Languages Course. *Innovative Technology in Computer Science Education, 1998*. ACM SIGCSE, Dublin, Ireland. 239-242.

Educator as Trainer: Technology in Action

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Abstract: Educators can make the transition from the classroom to a virtual environment to prepare graduate-level, web-based coursework in specific areas of technological expertise. These experts who have become knowledgeable in an area of technology can receive recognition for their efforts as they share this expertise with other educators. The steps educators take to become trainers and independent vendors of course work is both exhilarating and frustrating as new virtual spaces are created by teachers who have only known the four walls of their classroom. This paper examines the steps educators can take to become web-based independent vendors offering graduate-level, web-based courses to other teachers in their field of expertise.

Introduction:

In a recent study, Technology Counts '98, test scores demonstrated that "Computers can raise student achievement and even improve a school's climate" (Archer, 1998). The test scores of this report, 1996 National Assessment of Educational Progress, were analyzed for *Education Week* by Wenglinsky, a research scientist for Princeton University. These findings are significant to the position of this paper:

> Eighth graders whose teachers reported using computers primarily for drill-and-practice scored lower on NAEP--by more than half a grade level--than students whose teachers reported other primary uses of computers. Students whose teachers concentrated on simulations and applications, meanwhile, scored higher by two-fifths of a grade level.
>
> The same factors that were tied to better achievement also appeared to be linked to an improved school climate. Where teachers had professional development with computers and used them for teaching higher-order skills, schools tended to enjoy higher staff morale and lower absenteeism rates.
>
> Teachers who had received any amount of professional development with computers within the past five years were more likely to use computers in ways that Wenglinsky found to be more effective than teachers who had not received such training. (Archer, 1998)

If the evidence is conclusive that trained educators who use computers in effective ways to raise test scores and improve morale, then educators need to be the trainers for other educators. Many classroom educators have demonstrated tireless efforts to integrate technology in their teaching and learning process. Although these educators recognize their experience as invaluable, they lack the skills or know-how to present this expertise to a large audience. Who becomes technology trainers in educational settings is often a mystery and the infrastructure for the delivery of technology training is ambiguous. This is a memo I received from an educator enrolled in a graduate class:

> Hi Dr. Enns…I was reading the text and could not stop thinking about the possibilities of what I could do next year in my school district…there are chances for me to work as a technology specialist in the district…my questions are what can I do to *shine*, get noticed by others…I just wish to come across as a person who knows his stuff and demonstrates his confidence…I do not want to be overlooked. (Anonymous Graduate Student, 1998)

This is only one of many comments educators have made in my graduate level courses that have led me to develop a program called Technology in Action (Enns, July, 1998). By participating in this program, educators can learn to become web-based trainers as independent vendors.

Background

In 1989, a corporation, The Study Circles Series, Ltd., was formed to provide educational programs for teachers, parents and students. At first all courses were presented in on-site format, but with ever-advancing technological advancements, it is now possible to present courses in a web-based format. However, for the successful delivery of web-based courses, an infrastructure needs to be in place. First, educators need a web site to prepare and deliver web-based courses. Second, educators need a host or college or university that will validate course work and provide incentive or college credit for course work. The infrastructure for this program, Technology in Action, is presented as a web-based course at a privately owned web site, http://www.studycircles.net. In an agreement with the instructor, The University of St. Thomas in Minneapolis, MN, the course is approved for credit through their Continuing Education Program. Program information and course offerings are available at http://www.soe.stthomas.edu/websoew.

The idea for the program, Technology in Action, originated from my experiences in the early 1980s. Since the earliest applications of technology have been available to educators, some teachers have taken the initiative against all odds to integrate technology into their teaching and learning practice. Because these educators are active innovative practitioners who are stimulated by on-going technological advancements, they need opportunities to share their insights with other educators. Support for educators to become technology trainers is often not available or accessible for educators. Technology in Action prepares educators to teach other educators the technology they have found so successful in the classroom. Educators participate in a web-based course that follows a traditional format of three continuing education graduate-level semester credits. Throughout the course, educators actively experience the motivation and engagement of web-based instruction.

Reflective Active Participation:

The process of transition from educator to trainer and as independent vendor includes an understanding of reflective active participation. (Enns, March, 1998) In this collaborative learning process, educators focus on the organization of a digitized portfolio that includes a professional assessment of technology skills needed for training and web-base presentation. Educators are encouraged to engage in a web-based dialogue on the process of assessment leading to the mastery of technology skills needed for professionals who provide leadership and training. The following questions prompt educators to reflect on areas of expertise.

1. Briefly explain how you came to understand and use this technology in your teaching?
2. What experiences have you had with technology that will be of value to other teachers?
3. What specific technology skills are included in the integration of technology in your curriculum area?
4. What have you observed about student learning when you use these technology skills in the classroom?
5. Have you done any reading and research that supports the use of these technology skills in the classroom?

As educators gather their reflections on these questions, they are also gathering the beginnings of course descriptions, course objectives and references that will be used later in the course. What is important in this reflective stage is for educators to realize their own growth process and active engagement with technology. With this realization, educators can begin to consider how to disseminate their specific areas of expertise. Developing spaces for reflective activity strengthens the realization that constructive learning opportunities as events can successfully occur in web-based instruction. (Harasim, Hiltz, Teles & Turoff) The process for reflective active participation continues to provide an avenue to understand, manage and trust their own ability to provide innovative learning opportunities.

Introspective Assessment

Educators wonder if they will be able to train. They wonder if they can hold the attention of other adults. They wonder if the skills of trainers are the same as the skills for educators. As educators move through this process of introspection, it is helpful to offer them opportunities to engage in actual assessments that provide appropriate feedback and benchmarks for them to use as they consider their role as a trainer.

The *Learning With Technology Profile Tool* found at http://www.ncrel.org/capacity/profile/profile.htm offers educators a way to think about engaged learning with technology. It also assists educators in the selection of *current practice* and *best practice* indicators. This profile stimulates discussion and energizes educators to continue the assessment process in the transition from educator to trainer.

The MAPP, *Motivational Appraisal of Personal Potential* (IAN, 1995), is a diagnostic tool measures individual's potential and motivation for given vocational areas. This individual assessment can be taken by educators in a web-based format at http://www.assessment.com. The Personal Appraisal or print-out of this assessment provides a narrative and graphic representation of such areas as interest, temperament and aptitude. With this assessment, educators can analyze their motivational strengths as educators and as trainers. A study on the comparative data on educators and trainers is now in progress. When this study is complete, it will offer additional support for educators as they follow this assessment process.

Technology in Action

This is it! This is the educator's expertise. The experience the educators have had with technology in the classroom to promote successful learning is technology in action. It is this action that educators are encouraged to replicate and disseminate in a web-based course. As educators consider an instructional design that will be appropriate for the delivery of their area of expertise.

Reeves & Reeves provide ten dimensions of interactive learning that serves as a model as educators align course content with pedagogical and andragogical philosophies. This model offers educators choices and suggestions that permit flexibility and encouragement to be innovative in the instructional design of technology-based course content. (Khan, 1996 pp. 59-66) A representation of this model is also available at http://itech1.coe.uga.edu/higherEd/index.html.

Within the development of an instructional design, educators realize the learning experiences in a web-based environment as a series of events. Considering the learning experiences as events is helpful because a web-based course is not in a familiar classroom. Each learning experience must be pre-designed and thoughtfully prepared. Categorizing learning experiences by these seven events (Williams, 1980) is very helpful as educators move from classroom thinking to training in a web-based environment:

1. Motivational attention-getting events
2. Presentation Events
3. Observation Events
4. Experimental Events
5. Checking for Understanding Events
6. Energizing Events
7. Transfer Events

Through collaborative discussions, educators design, organize and construct teaching and learning activities that will form the series of events of their first graduate-level, web-based course. The process for reflective active participation introduced at the beginning of the course continues to provide an avenue to understand, manage and trust their own ability to provide innovative learning opportunities. Reflecting on such issues of pedagogy and andragogy in new learning environments challenges the deep-seated belief and value systems of teachers and trainers. Developing spaces for reflective activity strengthens the realization that constructive learning opportunities as events can successfully occur in web-based instruction.

Educators as Entrepreneurial Vendors

When educators prepare a web-based course and package it for delivery, it is their responsibility to find a college or university that will include the course in their existing programs. Educators may find that courses they design are picked up by their local educational institutions and marketed in-house. Many educators are satisfied with this delivery format while others seek a larger audience. It is a stretch for educators to gain an understanding of the role and responsibility of an independent vendor while realizing the potential to become entrepreneurial. Porter presents this challenge.

> Who should (or eventually will) participate in distance learning programs? Ideally, the answer is *everyone*. Although, that may not be practical, the possibility for reaching more people through distance learning is greater than ever before, as is the need to educate, train, or retrain greater numbers of people. (p. 5)

Educators who have been trained as classroom teachers appreciate a very basic orientation to the management process leading to the dissemination of course materials in a web-based environment. Such topics as software for course development, internet providers for course dissemination, and server access that accommodates database collections and strategies for marketing and advertising all present may questions that provide rich web-based discussions.

1. What is your greatest strength as a trainer?
2. How can you bring this strength into a web-based course?
3. Will your role as a vendor strengthen or challenge your best practice?
4. What weakness in your teaching/training may also surface in a web-based course?
5. Do you know a trainer who is an independent vendor?
6. Will you be comfortable being the only trainer you know who is also an independent vendor?
7. Will you be comfortable continuing as a classroom educator, but beginning your vendor endeavors?
8. Will the practice of an independent vendor change you in some way as a classroom educator?
9. Do you have moral or ethical concerns about becoming an independent vendor?
10. Will you be comfortable making money (maybe a lot of money) as an independent vendor?
11. Will you be comfortable if your course is financially a loss for several semesters until the concept catches on?
12. Can you manage money meaning that you will have to collect course fees and pay UST or other educational institutions for the credit. Can you separate profit from financial obligation?
13. What have been your entrepreneurial adventures to date?
14. Will you be prepared to make some financial investments to get your course going that may not be returned immediately?
15. Will you enjoy being the taking all the calls with concerns and questions about your course?
16. Will you be able to take and make calls from your home phone?
17. Will you be comfortable preparing mailings and marketing materials at home?
18. Do you have the resources at home to prepare course materials? Where will you go if you don't.
19. A distance course means that you may have students out of your calling area. Will you mind making long distance calls?
20. Will you enjoy the management of your course as well as teaching the course?
21. Will you be comfortable telling your friends that you are a trainer and an indpendent or private vendor?
22. Will it bother you to be teaching one course while preparing or marketing another one?
23. Will your role as an independent vendor change your family role at home?
24. Are you prepared to discuss these changes in advance or as they occur?
25. What will your family notice first about your change in roles?
26. Will you be comfortable working out of your home?
27. What frustrates you about risk-taking adventures?
28. Who will you call if you are frustrated?
29. Would you like to stay connected to others who are learning how to become independent vendors?
30. List five more questions that we can add to our collection.

Collegial Collaboration

Within a network of support provided by all educators who participate in Technology in Action, educators, now trainers, realize a safe haven for nurturing, mentoring and collegial collaboration as they share bumps and bruises of first-time web-based instructional experiences. Collegial collaborationS is not only an activity for participants in a web-based course, it is also a great support for trainers who are discovering new skills and innovative practices that transform the educational practice with every new experience. To give and receive support in the same web-based environment as the instruction, trainers gain confidence in new-found abilities to teach and learn.

The steps educators take to become trainers is a reflective process that leads to a greater understanding of models of learning and instructional systems design that leads to innovative and transforming web-based teaching and learning experiences. Those who have participated in this reflective discussion have offered these comments. (Anonymous Graduate Students, 1999)

Why are you interested in preparing a web-based course?

When I think of the time I waste driving to work, trying to reach people on the phone, waiting for late arrivals to class, I start dreaming of the day I can work like . . .

Wasn't the theory of gravity discovered while enjoying nature under the apple tree? Some days I think anyplace would be more conducive than a classroom without windows!!

My reflex response is that I need to be an independent teacher practitioner in order to continue earning and retire with my husband. But lately I have found their are many people who need a great deal of flexibility within the field of education in order to pursue their career goals. For the French teacher struggling with cancer, the family oriented with young children at home, The coach who is needed on site darn near 300 days of the year…online curriculum seems to have answers for them…

I agree. Flexibility is a major component that can determine the success of the prospective student. I have often contemplated the importance of deadlines and schedules, and realize they are impossible to escape from, but why must we be confined not only to a deadline, but a 9 to 5 workday as well. I have found that I am much more productive at times well outside of the typical workday, but this doesn't fit with our current paradigm of a day.

I see new dimensions appearing for the way we learn, and the way we teach. Any thing that I can touch someone. I am also interested in teaching adult learners for continuing education classes. It is surprising how little most teachers now about the computer in our school. The standard use is word-processing and grading programs, a few surf the net for fun. I would like to be able to help change that, along with bring in extra income if I decide to take time off to stay home to have a couple children. What better way to accomplish both than on line instruction?

References

Anonymous Graduate Student (personal communication, 1998)

Anonymous Graduate Students (personal communication, 1999)

Archer, J. (1998) The link to higher scores. *Education Week* [on-line], October, 1998. Available: http://www.edweek.org/sreports/tc98/ets/ets-n.htm

Enns, B. (July, 1998) *Technology in action.* A web-based graduated -level continuing education offered for teachers who were interesting in learning how to prepare a course for web-based instruction. St. Paul,MN:University of St. Thomas.

_____ (February, 1998) *Reflective Learning Technology.* Conference paper and presentation. Minnesota Association of Independent Schools Conference. St. Paul, MN.

_____ (March, 1998) *Reflective active participation in graduate education.* Conference paper and presentation. SITE 98 Society for Information Technology and Teacher Education (AACE) Washington, D.C.

Dertouzos, M. (1997) *What will be:how the new world of information will change our lives.* San Francisco:HarperEdge.

Forsyth, I. (1998) *Teaching and learning materials and the internet.* London:Kogan Page.

Harasim, L., Hiltz, S., Teles, L. & Turoff, M. (1997) *Learning networks:a field guide to teaching and learning online.* Cambridge, MA:MIT Press.

Johnson, S. (1997) *Interface culture:how new technology transforms the way we create and communicate.* San Francisco:HarperEdge.

Khan, B., Ed. (1997) *Web-based instruction.* Englewood Cliffs, NJ:Educational Technology Publications, Inc.

Lowery, J. (1998) *Netrepreneur:the dimensions of transferring your business model to the internet.* Indianapolis, IN:QUE.

Maier, P, Barnett, L., Warren, A. & Brunner, D. (1996) *Using Technology in Teaching and Learning.* London:Kogan Page.

MAPP Operating Systems (1995) International Assessment Network. IAN:Minneapolis, MN.

Porter, Lynette. (1997) *Creating the virtual classroom.* NewYork: Wiley Computer Publishing.
Turkle, S. (1995) *Life on the screen.* New York:Simmon & Schuster.
Williams, Miriam (1980). This instructional model was first introduced at the University of St. Thomas, St. Paul, MN by Dr. Miriam Williams, as chair and professor of the Organization and Learning Development Department.

Virtual Learning Spaces in the Web: an Agent-Based Architecture of Personalized Collaborative Learning Environment

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Abstract: This article reports on the results and future research work within the paradigm of Configurable Collaborative Distance Learning, which we have named EVA. The article focuses on the description of the main concepts, multiagent architecture, implementation of particular agents, software and LAN/ATM hardware platform developed for the EVA environment. Prototypes of agents have been developed using VC++, JAVA, LALO, and JATLite for Unix and Windows platforms.

1. Introduction

Since their conception, knowledge-based learning environments have offered significant potential for fundamentally changing the educational process [Mark & Greer 95, Chan 96, Youngblut 94]. Nevertheless, despite of many expectations, few learning environments have made the difficult transition from the laboratory to the classroom, so the development of pedagogically sound tools has been the time challenge. Recent trends in Web-based learning environments involve collaborative work as embodied in Computer Supported Cooperative Work for human-computer interaction and Distributed Artificial Intelligence for learning. These resulted from the proliferation of networks ranging from local sites to the Internet. Computer Supported Cooperative Learning (CSCL) systems have been built on the lessons learned from the past approaches such as Computer-Based Training, Intelligent Tutoring Systems and Interactive Learning Environments. Perhaps their most important significance is the ability to offer a collaborative environment that utilizes the experiences of other students, different teaching strategies, the recorded group expertise and the capabilities of software tools to arrive at a particular convergent solution in a group fashion.

The investigation project *EVA (Espacios Virtuales de Aprendizaje* in Spanish - *Virtual Learning Spaces)* applies the CSCL methodology to obtain a new paradigm of the Configurable Personalized Collaborative Learning [Núñez et al. 98]. This project is dedicated to the research and development of pedagogic models and information technologies that provide spaces of knowledge, collaboration, consulting, and experimentation for supporting the learning activities of teams separated geographically.

Agent technology is the promising way to approach these problems. The notion of agents is the central part of contemporary learning environments, where they act as virtual tutors, virtual students or learning companions, virtual personal assistants that help students to learn, mine information, manage and schedule their learning activities [Müller et al. 97, Barros & Perkusich 96, Gordon & Hall 98]. The main purpose of our project is to develop models, architectures and multi-agent environment for collaborative learning and experimentation. The focus of this paper is the multiagent system (MAS) architecture of the EVA environment.

2. EVA concepts

The main concepts of EVA are the following:

1. The Virtual Spaces of knowledge, collaboration, consultation and experimentation as the collection of agents and conventional software components working over the knowledge domains.
2. A "Multi-book" concept, a personalized electronic book, generated by concatenating of selected units of learning material (ULM) and associated personal and group learning activities along the learning trajectory for each knowledge domain.
3. The intensive use of agent-based tools

- as virtual tutors, virtual students or learning companions, virtual personal assistants that help students,
- for mining information, managing, planning and scheduling learning activities, information retrieval and filtering, student assistance and tracking for evaluation of their intentions and performance, and
- to organize the workgroups and groups activities, and re-configure their work and knowledge spaces.

The conceptual architecture of EVA is structured into four essential knowledge elements, which are information deposits and sets of programs called Virtual Learning Spaces. These spaces are: *knowledge* - all the necessary information to learn, *collaboration* - real and virtual companions that get together to learn, *consulting* - the teachers or tutors (also real and virtual), who give the right direction for learning and consult doubts, and *experimentation* - the practical work of the students in virtual environment to obtain practical knowledge and abilities. To represent knowledge we have proposed a model based on the hierarchy of domains and concept graph representation of knowledge and learning activities. This model is used for learning trajectory planning, virtual space configuration and student tracking.

3. Agents in EVA

The core of the EVA environment consist of a number of components, composed of a set of deliberative and auxiliary agents, considered below. Agents form the intermediate layer between the users and virtual spaces (fig. 1).

3.1 Multiagent environment of personal education

The environment of collaborative education and smart personal assistance for tutors and students, consists of several agent types:

Internet search and filtering agent (A_{SF}): automatically searches for additional teaching material in the Internet, not yet located in the Knowledge Space, according to student's learning trajectory and through natural language searching tools (such as Clasitex [Guzmán 98]). Synthesizes information compiled of several sources about the same topic and filter redundant and repetitive information.

Collaboration agent (A_C): compares student's academic development and profile to form collaboration groups, requests help or information from other assistants and make collaborative decisions on how to select, integrate, and order information to be shared between the tutor and students or inside the students group.

Personal advisor (A_{PA}): suggests a personalized study plan to student according to its academic formation, interests, abilities and advances, and modify study plan, if it is necessary. Selects, integrates, and orders the information to study; advises for the learning problem solving, tells where to find learning material and tests, help the student to choose sources, suggests topics of thesis or projects, indicates to the student virtual labs, where it can make practices. This agent communicates with the search agent to find information according to the topic, it communicates with collaboration agent to collaborate with the rest of the group members. Also reminds a student about events, conferences, videoconferences, courses, tasks, tests, etc.

Evaluator agent (A_E): verifies periodically the learning advances, tries to find causes of misunderstanding, communicates with the advisor agent to re-organize the information to study.

Our prototype of learning community incorporates also a *Group Monitor agent* (A_{GM}) and a *Learning companion* agent (A_{LC}). The most of agents have been implemented in JATLite package with rule-based inferencing capabilities, programmed in Jess [JATLite 98, Friedman-Hill 98]. All agents collaborate through the message passing mechanism in agent communication language (currently, KQML) [Finin et al. 97].

3.2 Multiagent planning

A learner navigates the virtual learning spaces by routes (*study plans*) suggested in an automatic manner by EVA. So, the purpose of the planning system is to design a particular learning trajectory for each student in the knowledge space, formed by ULM, which is organized in knowledge domains. At the next stage, personalized books, called Multibooks, are armed by concatenating of selected ULM along the learning trajectory for each knowledge domain. In the same way, groups of students with similar interests are arranged. Finally, student learning activities must be scheduled to satisfy temporal constraints.

Initial study plan and learning activities scheduling is generated on the bases (i) of student's initial knowledge in each area of Computer Science at the graduate level according to the model, proposed by the ACM [ACM 91], and detected, for example, at the admission exam stage, and (ii) his interests in terms of sub-specialty or separated courses from the area, which defines student's final state in the knowledge space. Initial student's knowledge is considered as initial conditions for the common domain.

To perform planning and scheduling within the MAS paradigm, we have proposed to associate a planning agent *(A_P)* with each domain model. When viewed from the perspective of the system goal, the global study plan appears as an AND-OR tree progressing from the system goal (at the root), down through goals and plans, to local plan fragments distributed among the agents. Constraints are associated with each node of the tree. Since local goals and decisions are interconnected, developed multistage negotiation algorithm provides means by which an agent can acquire enough knowledge to reason about the impact of his local decisions and modify its behavior accordingly to construct a globally consistent decision [Sheremetov & Núñez 99].

Learning Activities Planning System with Multistage Negotiation is implemented using JATLite. It is composed of *n* planning agents and a *coordinator agent,* which inherit their methods from the RouterClient class. Agents are implemented as JAVA applets, so they also inherit methods from the Applet and Frame (to support graphic interface) classes of JDK 1.2 package.

3.3 Agents for virtual laboratories

Even though the virtual learning environments has been studied from a pedagogical perspective in the last years, few researchers has formulated clear methodologies how to create Virtual Laboratories for to cooperation in the WWW [Rodriguez et al. 98, Forbus & Kenneth 96], even less based on Virtual Reality Modeling Language (VRML) scenarios [Lemays et al. 96].

The EVA project contemplate in an integrated way, the following key elements:

- Tele-presence, including the monitoring and smart remote control of systems.
- Computer aided experimentation (real and virtual).
- Assistance in performing the experiments that enables configuration, performing and explanation of results.
- Distributed and collaborative work environment, based on VR interfaces.

We've developed a CASE tool, called EasyVRML to assign more complex behaviors to the VRML scenarios in a more simple form then conventional tools [Quintero et al. 98] (fig. 2). VRML allows to change the object and agents features of a scene (shape, color, position, size, orientation, etc) in function of determined events through the script languages [Mitra et al. 95]. We have developed several applications for the experimentation space of "Distributed Intelligent Systems" and "Virtual Reality Design" courses, which allow the students to develop their agents, execute them and visualize their behavior in the virtual worlds. These agents include the following types: *Behavior Agent* (A_B), which visualization must be generated in virtual environment, *Interface Agent* (A_I) to generate a user's interface (a Web page) and to allow the user to control the *Behavior Agents,* and *Experimentation companion* (A_{EC}), which pertains to the learning companion type, discussed above.

Actually, the implementation scheme is based on the integration of four programming languages: (1) LALO like agent programming language, (2) VRML for the generation of the virtual environment and the graphical representation of these agents allowing to generate 3D representations of dynamical scenes through a browser, (3) VC++, resulting code of the compilation of LALO source programs, (4) Java programmed interface between VRML and VC++.

4. A Unifying Framework for Agents in EVA

Since there exist a great number of education technologies, pedagogical models and styles, as well as software technologies to be reflected in the architecture of potential learning environment, we need to be concerned about whether any software architecture has a possibility of outliving its designers and of providing a suitable foundation for unanticipated additions of significant new features. Current consensus on these issues is probably that the most robust unit of reusability is a "framework" making use of "objects" or "components" and agents [Bradshow et al. 97, Grimes & Potel 95, Smirnov & Sheremetov 99]. In EVA, we have prototyped various components of a framework, with agents providing dynamic coupling and interoperability between components using standard interfaces and data formats.

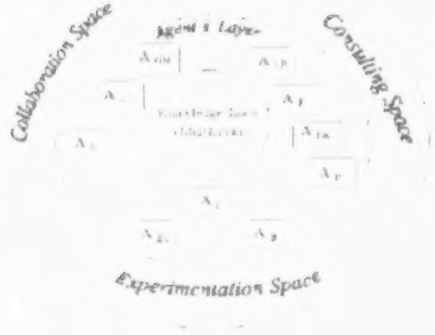

Figure 1. EVA conceptual architecture

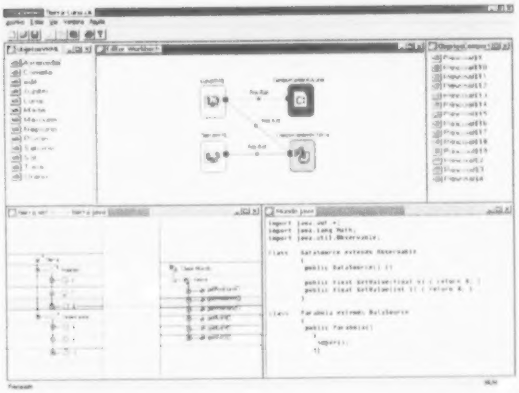

Figure 2. EasyVRML user interface

EVA agents are sorted into functional levels: presentation services, application services, management services, and data services. Agents providing presentation services are designed to hide the differences between viewers of different data types. From the point of view of the other agents, this means that there is a core viewer service protocol that is shared among all viewers. A viewer of a new kind of data need to implement an agent that converts this viewer service protocol to the specific call formats that the viewer application expects.

The application services level currently contains any agents supporting application services, discussed in the previous section of the article. Agent management services level is implemented according to the FIPA specification on the basis of the Microsoft DCOM model and includes the following components [FIPA 98, DCOM 96]:

- The Agent Communication Channel Router, which routes messages either to agents of the same platform or agents of different platforms.
- The Agent Management System, which coordinates the creation, erasing, suspension, resuming and authentication of agents in the platform.
- The Directory Facilitator, which holds a directory of services that offer each agent.

Finally, data services include *data locators* which encapsulate search and indexing functions, *data accessors* which retrieve data from heterogeneous data sources, and *data monitors* which feed information to clients based on user-configurable "push" policies.

Figure 3 shows the conceptual view of the overall EVA architecture, integrating principles of distributed object and agent technologies with the client-server architecture of the WEB. Specific client applications are built from various components that are integrated via an open presentation layer bus, such as Netscape's BeanConnect. The purpose of the bus is to allow HTML and client-side components (EVA agents, Java, JavaScript, plug-ins and ActiveX components, ORBs) to share a common object and messaging model, enabling seamless integration of tools, services, and user-interface elements.

Agent management services built on the foundation of existing distributed object services also allow agents the option of using a common agent-to-agent interlingua (currently, KQML) to communicate and coordinate their actions at the knowledge-level. In this case, EVA agents use an agent-to-agent (A2A) protocol that runs on top of standard lower-level protocols such as sockets or ORPC (for example, EVA planning and experimentation MAS). In addition to standard client-server connection protocols such as HTTP, RMI, and JDBC, a connection to a server-side DCOM component bus is provided and generic agent template with multi-level communication architecture, making use of KQML and ActiveX controls has been developed [Sheremetov & Smirnov 99]. This enables developers to selectively expose their interfaces, providing a standard way for system components to provide and access required services and data from each other. This not only ensures interoperability among our end-user tools and reusable components, but also allows us to take advantage of third-party DCOM and CORBA services that can be used and customized as needed.

The EVA Internet front-end (versión 1.0) with the above mentioned functionality is installed on WEB UNIX and WindowsNT servers Apache and Java Web Server. User interface in the knowledge space with personal advisor agent is depicted in fig. 4.

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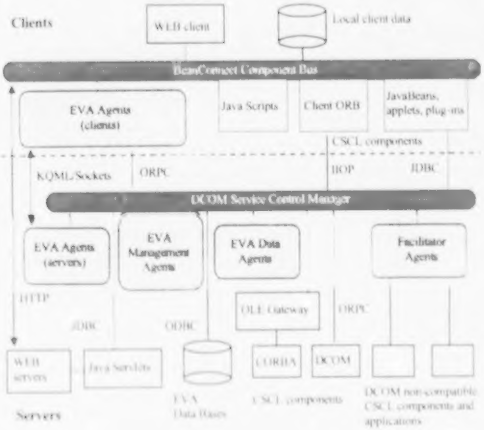
Clients
WEB client
Local client data
BeanConnect Component Bus
EVA Agents (clients)
Java Scripts
Client ORB
JavaBeans, applets, plug-ins
CSCL components
KQML/Sockets
ORPC
IIOP
JDBC
DCOM Service Control Manager
EVA Agents (servers)
EVA Management Agents
EVA Data Agents
Facilitator Agents
HTTP
JDBC
ODBC
OLE Gateway
ORPC
WEB servers
Java Servlets
CORBA
DCOM
EVA Data Bases
CSCL components
DCOM non-compatible CSCL components and applications
Servers

Figure 3. EVA Unifying Framework

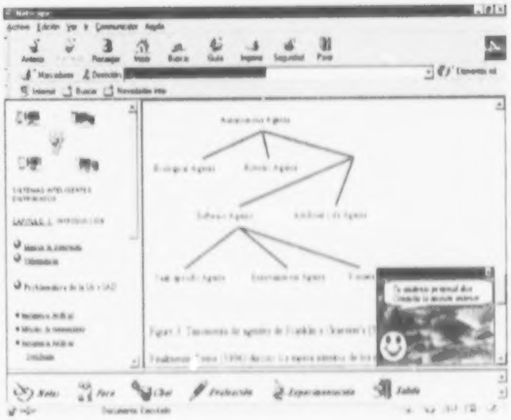
Archivo Edición Ver Ir Communicator Ayuda
Anterior
Recargar
Inicio
Buscar
Guía
Imprimir
Seguridad
Parar
Marcadores
Dirección
Internet
Buscar
Novedades
Nota
Foro
Chat
Evaluación
Experimentación
Salida

Figure 4. EVA user interface in the knowledge space

5. EVA platform

Developments like those proposed in this paper would not be possible without nowadays achievements of computer networking and telecommunications. So, we explore the advantages of the key communication technologies like Asynchronous Transfer Mode (ATM) and SONET (Synchronous Optical Network) as a transmission standard [Martinez & Su 99]. Then, to be able to test the EVA environment, the LAN/ATM based Experimental Distance Learning Laboratory was installed. The core of the system is an ATM switch with 8 gates at 155 Mbps, with the possibility to extend the capacity up to 622 Mbps, connected to the IPN ATM backbone and to an ATM LAN switch with 24 Ethernet inputs (10 Megabits each).

This Laboratory is the key element for the development of the ATM Experimental Center of Information Exchange, where the following on-going projects are being developed:

- Development, implementation and testing of teaching/learning activities in EVA environment
- Testing of performance of multimedia applications via assignment of virtual channels and bandwidth of the LAN/ATM network
- Transmission of signals and images over ATM using different compression techniques.

We also consider as the future work the integration of the Center into the Internet2 Mexican initiative, which is now at the planning stage and will be operative in 2001.

6. Conclusions

The EVA environment makes intensive use of agent technology, developing models, architectures and multi-agent environment for collaborative learning and experimentation, such as (i) multiagent generic open environment, based on federation architecture, models of knowledge sharing, and generic agent template with multi-level communication architecture, making use of KQML and ActiveX controls, (ii) personal learning assistants with information filtering capabilities (iii) agents for individual and collaborative learning with artificial learning companions, (iv) agents for planning of learning trajectories, and (v) multiagent experimentation space.

EVA is effectively used by the students of the CIC-IPN in the domain of the Master and Doctorate education in Computer Science. At the current stage of the experiment we are also developing the course on "The Potential of Virtual Reality in the Teaching of Engineering" to be delivered at the University level for about 200 teachers of engineering. We are working in a strict evaluation of the improvements brought by the mentioned techniques.

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7. References

[ACM, 91] Computing as a Discipline, ACM report, 1991.

Barros Costa, E., & Perkusich, A.(1996). Modeling the Cooperative Interaction in a Teaching/Learning Situation. In *Intelligent Tutoring Systems*: 168-176.

Bradshaw, J. M., Dutfield, S., Benoit, P., & Woolley, J. D. (1997). KAoS: Toward an industrial-strength generic agent architecture. In J. M. Bradshaw (Ed.), *Software Agents*. Cambridge, MA: AAAI/MIT Press: 375-418.

Chan, T.W. (1996).Learning companion Systems, Social Learning Systems, and Intelligent Virtual Classroom, *In Proc. of the World Congress on AI in Education*, 1996, Vol. 7, No. 2, 125-159.

Distributed Component Object Model protocol DCOM/1.0 (1996), Network Working Group.

Finin, T., Labrou, Ya., & Mayfield J. (1997) KQML as an agent communication language, in J. Bradshaw, ed., Software Agents, AAAI/MIT Press, 1997.

FIPA7412, (1998). Draft 1.0, document of the Foundation for Intelligent Physical Agents (FIPA).

Forbus, D. & Kenneth, (1996). Articulate Virtual Laboratories for Science and Engineering Education; http://www.qrg.ils.nwu.edu/projects/NSF/avl.htm

Gordon, A. & Hall, L. (1998).Collaboration with Agents in a Virtual World. *In Proc. of the Workshop on Current Trends and Artificial Intelligence in Education, 4 World Congress on Expert Systems*, Mexico, 1998.

Grimes, J. & Potel, M. (1995). Software is headed toward object-oriented components. *IEEE Computer*(August), 24-25.

Guzmán A. (1998). Finding the main themes in a Spanish document. *Journal Expert Systems with Applications*, Vol. 14, No. 1/2, Jan/Feb. 139-148.

JATLite Beta Complete Documentation (1998), Stanford University, http://java.stanford.edu

Lemays, L., Murdock, K., & Couch J. (1996). 3D Graphics and VRML 2, *Sams Net*.

Mark, M.A., and Greer, J.E. (1995) The VCR tutor: Effective Instruction for Device Operation. *Journal of the Learning Sciences*, 4(2):209-246.

Martínez J. & Su, J. (1999) La investigación en redes por conmutación de celdas en el CIC IPN: resultados obtenidos e investigaciones en curso. *Int. Conference CIMAF'99*, March 22 - March 26, La Habana, Cuba.

Mitra, Yasuaki Honda, Kouichi Matsuda, Gavin Bell, Chee Yu, Chris Marrin (1995), Moving Worlds: behaviors for VRML, http://www.vrml.sgi.com/spec.html

Müller, J., Wooldridge, M. J. and Jennings, N. R. eds.(1997), Intelligent Agents III: Proc. of the 3rd Int. Workshop on Agent Theories, Architectures, and Languages, *Lecture Notes in Artificial Intelligence*, Vol. 1193, (Springer-Verlag, Berlin, 1997)

Nuñez, G., Sheremetov, L., Martinez, J., Guzmán, A., & Albornoz, A. (1998). The Eva Teleteaching Project - The Concept And The First Experience In The Development Of Virtual Learning Spaces. *In Proceedings of the 15th IFIP World Computer Congress "The Global Information Society on the Way to the Next Millennium"*, Vienna and Budapest, 31 August - 4 September, Part II, 769-778.

Quintero, R., Armenta, A., Balladares, L. & Nuñez G. (1998). EasyVRML Herramienta CASE para la asignación de comportamiento a componentes de mundo VRML. *XI Congreso Nacional ANIEI*, Mexico, 1998 (in Spanish)

Rodrigues de Queiroz, L. et al. (1998). A Robotics and Computer Vision Virtual Laboratory, IEEE'98 In *Proceedings of AMC'98*, Coimbra, June29-July 1, 694-699.

Sheremetov, L. & Núñez, G. (1999). Multi-Stage Cooperation Algorithm and Tools for Agent-Based Planning and Scheduling in Virtual Learning Environment, The 1st International Workshop of Central and Eastern Europe on Multi-agent Systems (CEEMAS'99), 30th May-3rd June, St. Petersburg, Russia. (to appear)

Sheremetov, L.B. & Smirnov, A.V. (1999). Component Integration Framework For Manufacturing Systems Re-Engineering Based In Agents And Objects. *International Journal of Robotics and Autonomous Systems*, Elsevier, North-Holland, (to appear).

Youngblut, Ch. (1994) Government - Sponsored Research and Development Efforts in the Area of Intelligent Tutoring Systems. Institute for Defense Analyses, USA.

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Telementoring Middle School Girls: Eyes to the Future

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Abstract: This paper describes the design and initial finding of an innovative mentoring program which connects middle-school (MS) girls of all abilities to female mentors working in math and science related fields. The purpose of the project was to provide urban middle-school youth with role models who have pursued math and science in high school and beyond. Unlike many school-to-work initiatives which inspire young adolescents to think about alternative long-term futures, this project also concentrated on the path that lies more immediately ahead of MS students -- high school. The paper provides evidence of the power of a long-term mentorship program to engage students of all levels of academic achievement with the content of math and science, and with issues particular to female students in MST. This project was funded by Arthur D. Little, Inc. and is housed at TERC, Inc. of Cambridge, MA.

There is still a wide gap in girls' achievement and rates of enrollment in science courses in comparison with boys. The gender gap in attitude and achievement progressively widens from age 9 through twelfth grade (Kahle & Meece, 1994).

Studies suggest that girls benefit from engagement with adult mentors through increased knowledge about possible future paths and improved self-confidence with regard to Science, Math and Technology. Adult mentors can supply emotional and academic support critically needed in the transitional period from middle school to high school (Campbell, 1990; Gilligan et al., 1990; Kahle et al., 1993; Nightingale & Wolverton, 1993; Kahle, 1987, 1989). Role models also can provide students with personal connections to possible futures that they would not otherwise believe to be within their reach. This may be especially important if parents do not or cannot provide such role modeling. While several projects have connected high-school girls with women in the workforce, less is known about the benefits that can result when middle-school girls have high-school girls as mentors, in addition to adult mentors.

Context

The "Eyes to the Future" program began with a pilot in the fall of 1997 in collaboration with one middle school and one high school in Somerville MA. The first phase of the pilot included one month of recruitment, training, and website design and three months of communications among the fifteen middle-school girls, five high-school girls, and five adult women who took part. Middle-school students were selected on a "first come" basis and represented a wide range of academic achievement as well as broad ethnic diversity. The HS students were selected with the help of the HS science coordinator who sought students known to be responsible, engaging, and strong in math, science, and technology (MST). The adult mentors were selected by following students' interests and included a boat builder-engineer, an ecologist, a veterinary technician, a pediatrician, and a geologist. TERC and school staff met weekly with the middle-school girls to facilitate activities. Over the course of three months, the middle-school girls and the high-school and adult mentors communicated frequently through the website, and every member participated.

The success of this pilot led to the program's expansion in the 1998-1999 school year. This second phase involved the development of an interactive website that would facilitate communication, sharing of science projects, space for personal reflection and the creation on a collaborative book that would document the students experiences on the project. The project was implemented during the second year in two middle schools: the West Somerville Neighborhood School in Somerville, and the Devotion School in Brookline (MA). It involved 30 middle school students, 10 high school students and ten adult mentors.

The current paper will focus on results of our first year's experience in the fall of 1997 and the subsequent design of an interactive website that emerged from this work.

Data Sources

Data used for this study were drawn from several sources. All network conversations between participants were archived as text files. In addition, there were focus groups with the middle-school and the high-school girls, face-to-face and electronic conversations with the participating teacher and mentors, and background questionnaires from the middle-school and high-school girls. Qualitative data were read and coded by two researchers, seeking themes and patterns within and between groups. Themes that emerged were discussed with the participating teacher.

Our findings address the following research questions:

- What were important themes that emerged from the mixed-age dialogues?
- What were the relative contributions of high-school and adult mentors?
- In addition we present the main features of the interactive website which emerged from this initial round of work.

Results and Discussion

Themes that emerged from dialogue between middle-school girls and high-school mentors

Middle-school students communicated for a period of approximately twelve weeks with their high-school mentors. The messages were often complex, containing many topics. It was common for a message to contain personal information, some questions about high school, a funny vignette that occurred at school, as well as a request for help on a science project.

The middle-school girls represented a broad range of academic ability and several were doing poorly in school. In contrast, all the high-school mentors were selected because they had pursued math and science in high school. Further, the high-school girls had different ethnic backgrounds from those of the middle-school girls. Initially, we questioned how these two groups would relate. Our fear was unfounded, as all five groups of middle-school students (three middle-school students were paired with each high-school mentor) related well to their mentors.

The following themes were most salient in the dialogue between middle-school girls and their high-school mentors.

Providing affective support

The tenor of the conversation between middle-school students and their high-school mentors was very personal and friendly. On each team three middle-school girls communicated with one HS mentor and one adult mentor. Even though the middle-school girls knew that all five people could read each message, they were surprisingly not self-conscious about the content of their messages. Frequently, the middle-school students shared their success, failures, and fears about high school with their mentors. Middle-school students wrote when they did well on their report cards and sought advice when they received poor grades on report cards or tests. The middle-school students wrote about subjects that were difficult for them and shared fears that they had about the transition to high school. The high-school girls showed remarkable sensitivity in answering personal queries and provided a great deal of affective support.

The high-school girls sent many messages that seemed to invite a personal dialogue.

From C++ (high school mentor): Now it's your turn to talk about yourself. Tell me anything you want me to know, anything you feel comfortable with, no pressure. Our main subject is SCIENCE & MATH, but we can bend the rules a bit. We can talk about anything (appropriate). If we do get off track too much, I'll steer us back.

In turn, middle-school students felt free to share their fears.

In a sense I am a little scared to go into the high next year. Even though this school is pretty big, the first school I went to was only one floor and one room per grade. It was called the Conwell. I hope at the High that I can join lots of clubs and stuff to keep me busy like I am now.

Learning about High School: the culture, the classes, the clubs, and the teachers.

When the middle-school girls began to converse with the high-school students it became apparent how important it was that these students came from the same district. Many messages helped to demystify the high school for the middle-school girls. The high-school students provided details about life in Somerville High School. They described the school's physical layout, interesting classes, supportive teachers to look for, and a wealth of knowledge about clubs that would support peer interactions as well as continued involvement in science and math. Furthermore, they passed on lessons they had learned about how to succeed in challenging classes, or with difficult teachers.

...High-school is actually not that intimidating....It's big, but very accessible. Room 100's are on the 1st floor (basement) 200's on the second floor...And the rooms are in numerical order. English has its own english wing...science has its own section. There are lots of clubs in the high-school. Science Club is definitely one club you should consider....

Providing a positive image about hard working students

The high school mentors often talk about working hard but reaping the benefits of their effort. They were clear that they balanced work with other interests such as dance, tennis, and socializing, but that they took their work seriously. One middle school student writes of being self conscious of doing "too well."

Sometimes I feel stupid when I get my report card. I get A's and B's, mostly all A's. Sometimes I feel stupid because other people call me a geek and say I'm too smart. I'm proud of my accomplishments, but I feel really bad when people make fun of me.

Her high school mentor is able to reassure her: Before I go I want to answer the question to J.T.S. about her grades. I think that you shouldn't worry about what other people think of you. Most of them are just jealous because they can't get the grades you do. When you get to high school, nobody really has problems with people getting good grades.

Positive view of Math, Science, and Technology

Perhaps one of the most valuable contributions of the high school students was their genuine enthusiasm for math and science. They were unabashedly excited about these subjects and very expressive about why they thought middle school girls should pursue them.

Well, I think science is THE most interesting subject, because it is infinite, but my absolute favorite is bio. There is no end to biology. Everything will always evolve into something totally different. However, other science are also neat. Because I like bio so much, I plan on taking pre-med in college. There are so many interesting things in the scientific world. Opportunities are endless. Even computer science is an expanding field.

Middle school students appealed to the high school students for help in selecting science projects. Here too, the high school girls showed good judgement, giving suggestions but not doing the work for them. A little bit of advice and encouragement seemed to go a long way.

(From HS mentor): Like I said to Micaela, tell me what you're interested in and I'll help you think of a topic. It's no use for me to suggest a topic that you have absolutely NO interest in. Tell me what areas you like. Hey, you should be proud that you won first in the 7th grade division. You did better than I did. What was your project on? Maybe you can expand upon it. Hint: When you get to high school, judges ABSOLUTELY LOVE long term projects that you've been doing for years. Have to finish homework.. talk to you later.

Themes that emerged from the dialogue between middle school girls and high school mentors

The dialogue between the middle school girls and the adult women was a bit more stilted than the one between middle school and high school students. Middle school students did not know how to begin the conversation. During an after-school session they "brainstormed" the following questions:

- What was the scariest case you ever experienced?
- What was the rarest disease that you've ever experienced?
- Do you use math and science when you work?
- When did you decide you'd like to do this job?
- What made you want to do this job?
- How does it feel to be a woman in a man's field?
- What kind of boats do you build?
- Are physics and engineering closely related?
- Aren't boat builders usually men?
- What's the worst environmental problem you've every dealt with?

- What skills do you need for your job?

Theme: math and science in careers

Whereas the high-school girls were able to realistically depict challenges that the middle-school students would face in the near term, the adult mentors broadened students' visions of possible long term futures. The adult women were able to relate why math and science were important for their jobs. This practical, real world application of these subject matters gave these subjects a different focus other than good grades or school success.

Some answers to your questions…I use math and science at work all the time. Some examples: When we have to figure out how much medication to give an animal we have to use math and base the dose of medication on how much the patient weighs. Just yesterday I helped to give medication to some salamanders and we had to use math to decide how much to give them. We do lots of tests using the microscope to diagnose a problem. For fish, we can see if they have any parasites...

Discussions about Gender issues

In terms of the teams, the girls raised the question of gender roles with their women mentors. The women were able to acknowledge the reality of role-stereotypes, while offering their own experience of success despite the difficulties:

Message: So, what is it like in a man's profession? I have to say it is a little strange… I am pretty certain that I am the only woman in the US that makes her living repairing this kind of boat… Why did I decide to get into the 'boat business?' Well, as an engineer who studied Aeronautics and Astronautics, my job choices involved a lot of Defense Industry positions. I was not comfortable with the idea of building better jets to better bombs or anything connected with wars and killing people. As a boat builder, I could still be creative as an engineer and work on something that I enjoyed.

Relative contributions of high-school and adult mentors?

The HS girls provided a concrete perspective on the MS girls' immediate future, in HS, which the women mentors did not. Because of their closeness in age, they were able to function as role models in a way that the women couldn't. They thus emerged as very powerful mentors, whose contribution was unique and complementary to that of the adult women. The MS girls had a harder time initiating conversations with the adult mentors than they had with the high-school students. There were instances where slang used by MS students was not immediately understood by mentors, and instances where mentor's writings seemed too dense or complex. Once the conversations got rolling, however, the women's real world experience provided great opportunities for middle-school students to reflect and question "Why do you need math and science anyway?" Middle-school students were able to see that both HS students and adults continue to struggle with conflicts, uncertainties, time constraints, and difficult decisions.

Design of an interactive website to serve an expanded implementation

Whereas our first pilot version of "Eyes to the Future" was implemented using a very simple software tool that served the small group of participants, but was not structured to be scaled up, and was seen to lack functionalities needed for the full implementation of the program. During the fall of 1998, a fully interactive website was developed. The site is user-friendly and extremely intuitive for middle-school students who may have no prior experience with the Web. The site provides a way for middle-school students to communicate with each other, with HS mentors and with adults in the workplace, without needing an e-mail account. It supports collaborative writing, and the formation of school "electronic books" to be shared with other schools. It also provides support for collaborative science projects. It allows for district-wide participation, and for participation from more than one school district.

The site had six main sections:

- An interactive database that can be updated by the users. The interactive database allows girls to find out more about each other while also serving as a research tool for TERC staff. The database allows us to archive all submissions and to track them by individual, class or school.

- An area for mixed age discussions for teams composed of three middle school students, one high school student and one adult mentor
- An area for peer discussions. Since each group has both shared and discrete issues and interests, we created private discussions for middle school girls only, for high school girls only, for adult mentors only and for teachers.
- A personal scrapbook where middle school students annotated particular messages that were meaningful to them.
- A collaborative writing area, where teams of students contributed to a school wide electronic book that recorded their experiences. The school "book" was organized into chapters that included: initial reflections, role models in math and science, getting around in high school, math and science in high school, science projects, adult mentors and careers, and final thoughts.
- A collaborative research area where students can share ideas, writings, and products of science projects and get feedback, encouragement and comments from their high school and adult mentors

Summary:

The middle-school girls showed significant anxiety about entering high school and lacked knowledge about clubs, peer groups, and supportive teachers that could support their Science, Math and Technology learning and achievement. High-school girls provided encouragement and valuable information about navigating high school while staying engaged with Science, Math and Technology, such as study tips, ways to cope with academic problems and find supportive teachers, consequences of course choices, and ways to locate math and science clubs and other supportive peer groups. Their advice was particularly valuable because they attended the high school which the middle-school students would be attending in the near future. High-school girls helped facilitate the conversation between middle-school girls and adult mentors, effectively bridging a "generation gap." The high school girls also benefited from rich dialogues with adult mentors as they sought advice on their academic and career goals.

Adult women provided middle-school girls with valuable insights into careers involving Science, Math and Technology by discussing how they decided on their professions, how they used science and math at work, what schooling was needed to pursue such a profession, what challenges they faced, and what it felt like to be in a male-dominated field.

Our findings suggest that a network-supported mentorship program can provide important content and motivation in math, science and technology for middle-school girls The pilot suggests important complementary roles for high-school and adult mentors in the program, and several salient themes arising from discussions among the participants. Discussion and presentation of the interactive website addresses how the technology can enable, and enhance facilitated conversation and collaboration among these three communities of middle school, high school, and the work place.

References

Campbell, P. (1990). *Eureka! Participant Follow-up Analysis.* Groton, MA: Campbell-Kibler Associates.

Gillian , C., Rogers, A., & Brown, L.M. (1996). *Soundings into Development.* In Gillian, C., N. P. Lyons, & T.J. Hanner (Eds.), Making connections (pp. 314-329). Cambridge, MA: Harvard University Press.

Kahle, J. B. & J. Meece. (1994). Research on gender issues in the classroom. In D. L. Gabel, (Eds.), *Handbook of Research on Science Teaching and Learning* (pp. 542–557). New York: Macmillan Publishing Co.

Lispsitz, J., H.M. Mizell, A.W. Jackson, and L.M. Austin. 1997. Speaking with one voice: a manifesto for middle-grades reform. *Phi Delta Kappan*, March, 1997, pp. 533-540.

Nightingale, E.O. and L. Wolverton. 1993. Adolescent Rolelessness in Modern Society. In Takanishi, R. (ed.) *Adolescence in the 1990s.* New York: Teachers College Press. pp. 14-28.

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The Development of an All-in-one Virtual Campus From Ground Zero

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Abstract The purpose of this paper is to share our experiences in developing a unique all-in-one virtual university. The Defense Acquisition University virtual campus is a unique model for web based instruction because it integrates all aspects of managing a corporate university while providing myriad dynamic layers of access privileges. The OSS provides functionality in 16 main areas: DAU Public Website, Registration, Enrollment , Login , OSS User Types, OSS Collaboration Tools, Search , History, Logs, Reports, Canned Email, Feedback, Help, Courseware Interfaces, Test Application , and Database Interfaces. We are currently on the fourth build of the system and have since added many new features and functions since its inception. Given the conference's paper restrictions for length, we have attempted to squeeze as much information as possible regarding the DAU's Virtual Campus. However, the information is best conveyed through a live presentation and a demo of the site. We welcome additional comments and questions regarding the site and our presentation.

Introduction

The purpose of this paper is to share our experiences in developing a unique all-in-one corporate university with the hope you will prevent non-desirable occurrences and glean the positive attributes in your own development of a virtual campus. The Operational Support System (OSS), https://dau.fedworld.gov/dau/index2.htm is the web-enabled GroupWare based administrative infrastructure used by the Defense Acquisition University (DAU) to support its effort in migrating its teaching approach to embrace distance learning concepts in a virtual campus milieu. Several commercial products were examined and failed to perform all of the functions contained in the OSS. Consequently, Booze Allen & Hamilton, Inc developed the OSS under contract. The OSS supports student registration, tracking, courseware distribution, scheduling, and a help desk. Other functions include the ability to maintain course schedules and information, schedule classes at various schools, allocate quotas, manage class registration, maintain class rosters, maintain a grade book, and historical training information. The OSS has 16 main functions and is dynamically layered according various roles and access privileges.

Why is DAU Transitioning to the OSS?

The Defense Acquisition University is a consortium of Department of Defense education and training institutions and organizations that provides mandatory and assignment-specific courses for military and civilian personnel serving in 11 acquisition career fields. The DAU's mission is to educate and train professionals for effective service in the defense acquisition system.

The DAU is anticipating a number of changes in the makeup of the DoD acquisition workforce. Over the next several years, the DoD acquisition workforce will increase in number from approximately 105,000 to 180,000 or more. Although the DAU student population will increase significantly, DAU will not experience an increase in funding. In response to this situation, the DAU Board of Visitors has recommended that DAU apply technology to its training and educational curriculum. Additional guidance on moving to technology-supported education and training has been provided by the Under Secretary of Defense (AT&T) and the Vice President of the United States.

To meet these directions and to permit maximum access and most efficient use by the acquisition workforce, DAU chose to use the latest educational technologies to design an integrated and accessible distributed education system. The overall objective of DAU's distance education system is to provide a more easily accessible, high quality program of instruction that will help the acquisition workforce acquire the skills and information necessary to keep pace with today's changing world. Specifically, the development of the system is guided by the following DAU educational requirements: provide access to all DAU education and training through a single portal, support materials developed using any DAU selected authoring tools, manage all delivery modes for all courses, maintain an open system for sharing of data and course materials (i.e., support the sharing of information/training modules with all who have a need for them), and provide centralized administration with distributed management of university functions.

As part of this distance education system initiative, DAU is migrating its teaching strategy to embrace distance learning concepts. The effort includes the analysis, design, and implementation of courseware to be delivered using web-enabled technology as well as extensive application development for the web-enabled administrative infrastructure. This administrative infrastructure is the Operational Support System (OSS).

The DAU Public Website serves as the DAU home page. The DAU Public Website is displayed when a user initially accesses the OSS. Visitors to the DAU Public Website include DoD personnel; authorized non-DoD personnel authorized to formally take DAU courses, and visitors (non-DoD personnel. The DAU Public Website provides users with the ability to register for DAU accounts, and log in to access full OSS functionality and on-line courses, and has an online catalog containing general information about DAU.

The DAU Virtual Campus serves as the user's Home Desktop within the OSS. The user's DAU Virtual Campus Desktop is displayed when a user logs in to the OSS. Access to the DAU Virtual Campus is limited to authorized users with OSS accounts, including DoD personnel and non-DoD personnel authorized to take DAU courses. The OSS collaboration tools and other functions available at this level include Task, News, Library, Glossary, Forum, FAQ, Email, Chat, Calendar, Utilities, Feedback, Search, Reports, User Directory, Site Map, Help, and Logout. The functions available to a user at the DAU Virtual Campus vary depending on the user's role. Depending on their user role, approved users of the DAU Virtual Campus can access specific DAU online training courses, administer courses and users, manage course enrollment, access the Help Desk, register for online training courses, view their course enrollment history, and generate system reports. All users have the capability to maintain their personal information including password and personnel information from the DAU Virtual Campus. The OSS automatically logs out any user that has been logged in with no system activity after 4 hours.

What is the Purpose of the OSS?

The purpose of the OSS is to provide system users such as instructors, students, schools, registrars, etc. with the tools necessary to deliver computer-based training (CBT) courses over the Internet, enroll in training courses, schedule training courses, manage course quotas and registrations, collaborate with others, etc. The OSS contains all the functionality necessary to provided a uniform delivery of courseware. The OSS operates as the student management infrastructure to present web-enabled courseware as well as all DAU necessary operational functionality. To support DAU, the OSS supports the following components.

Student Registration - The creation and maintenance of user accounts. The student registration function verifies that users are DoD authorized users and provides different templates depending on the users roles. User roles are defined in Section 2 and are based on the privilege model.

Course Enrollment - The access of on-line course and registration in any DAU onsite course. The system maintains a course schedule and allows students to register based on certain prerequisites. Course enrollment verifies prerequisites as well as provides a waiver process to allow a student into a course.

Test Delivery - The course administrator can centrally set up the test delivery engine to the specific course needs. This includes course, lesson, and terminal learning objective level tests generated at random from a question pool. The test engine selects one question per enabling learning objective for each test. Questions are not repeated until the student has used all questions in the pool. Answers and distracters are also presented at random. The test function supports multiple choice, all that apply, sorting, matching, and fill in the blank questions. Images can also be used as questions or distracters or to enhance the test. Test item analysis is also conducted as a report feature in the system.

Course Evaluation - A survey is available during and after the course to provide feedback on the students feeling on the course and course delivery. The course evaluation is based on a survey engine that supports dimensions and categories.

Student Tracking - User progress as well as bookmarking is provided by the system. The student or instructor can see student progress and analyze course material. The grade book feature allows instructors to compile evaluation material for non-self contained courses.

Report Generation - The system has a number of pre-canned reports to support student tracking and management.

Problem Resolution - A trouble ticket system exists to support students having problems, tracking issues, and determined enhancements. Trouble tickets are routed to second tier help desk personnel. Tickets are resolved or forwarded to a party that can resolve the tickets in an expeditious manner. The tier 1 help desk is supported at The National Technical Information Service (NTIS) with tickets generated from the on-line feedback or calls made to the help desk. The National Technical Information Service is the federal government's central source for the sale of scientific, technical, engineering, and related business information produced by or for the U.S. government.

Site Collaboration - A host of collaboration tools such as forums, IRC's, news, library, tasks, and calendar, are available for asynchronous and synchronous communication. The tools can be used for homework, teams, or to present site-specific information.

DAU's Approach to Developing Courseware

The DAU web-based learning environment is designed to support both procedural training and more complex cognitive training related to decision making and problem solving. Simple HTML-based lessons are used when presenting basic procedural information. In other courses requiring students to responding to complex cognitive stimuli encountered on the job; AuthorWare lessons, video teletraining, web conferencing, or other methods are combined with the HTML environment to address these more complex learning outcomes.

Performance outcomes refer to the task and performance levels desired of students during and after completing the course. Typically, a courseware developer would ask the following questions related to performance outcomes during analysis: What are the primary tasks to be trained? What are the characteristics of the desired task performance? Is the task primarily procedural or cognitive? What are the current and desired performance levels?

Learner interactions refer to the predominant learning styles, diversity and motivation of the student population. Typically, a courseware developer would ask the following questions related to learner interactions during analysis: Do members of the target student population have strong learning style preferences? How diverse are the members of the student population? What types of collaborative learning are desired? How motivated are the students to learn the course content?

In addition, DAU recommends that courseware developers address the following five areas related to learner interactions:

Layering Information – DAU students have diverse backgrounds and prior training experiences. Therefore, it is essential to allow students' access to layered or "popup information" for additional explanations of terms and concepts. By layering information, students who know the material have the option to bypass it.

Maximizing Student Control – Students are given learner control for the majority of the pathways through the lessons. A recommended sequence is provided, but students are allowed to select their own pathways after completing the first lesson.

Managing Web Surfing – Web links within lessons need to be managed carefully, since some students who are unfamiliar with the web environment may be unable to find their way back to the lesson after following an embedded web link. Therefore, students are offered selected web links after completing the core lesson materials. This is accomplished by providing web links on a lesson exit page, so students can complete the lesson before following the recommended links.

Encouraging Collaboration – Both synchronous and asynchronous forums are offered to students. Because most students are taking courses while on the job, asynchronous communication modes are preferred.

Motivating Students – Motivation can be addressed by creating simulated characters that reappear throughout the lessons, using appropriate humor, and sending personalized email messages from an assigned faculty member when milestones are accomplished.

Testing and Evaluation

Testing and evaluation refers to the students' mastery of the course content after completing the course. Typically, a courseware developer would ask the following questions related to testing and evaluation during analysis: What types of testing will be administered? What types of test security will be required? What if students fail to demonstrate mastery of the course content? Will follow-up data be collected?

Currently, DAU suggests courseware developers consider the following three areas related to testing and evaluation:

Test Security Issues – DAU students are required to complete courses as part of job certification requirements. Therefore, testing is critical. DAU addresses test security using the following strategies:

- Random generation of test items from test item pools so that students get unique combinations of test items
- Random placement of distracters within test items
- Comparison of performance within lesson quizzes to final test performance
- Inclusion of test items that are difficult enough to be valid if the student uses references.

Testing as a Learning Activity – For most courses, DAU students are allowed three attempts to achieve 100% mastery on the lesson's learning objectives. If a student fails to demonstrate mastery, the student is told to contact his/her assigned faculty member. The faculty member also receives a notice that the student has failed to reach full mastery. The faculty member reviews the questions missed on each attempt. Based on this item analysis, the faculty member develops an individualized plan for helping the student improve his/her performance. When the faculty member is satisfied the student has mastered the test material, he/she can automatically override the student's tests results.

Student–Faculty Interactions

Student–faculty interactions are an important component in the development of courseware. Typically, a developer would ask the following questions related to student–faculty interactions during analysis: What types of interaction are required between students and faculty? What is the anticipated faculty-to-student ratio? Will students be assigned to faculty in cohorts?

DAU recommends that courseware developers address the following three areas related to student–faculty interactions:

Individual Faculty Assignments – Each DAU student is assigned to a faculty member. After registering for the course, the student receives an email message with a greeting from the assigned faculty member. Subsequent communication with faculty are based on the course being presented and the student's needs. The environment provides for: synchronous and asynchronous private conferences between faculty and students, customized and automatic email messages, an instant feedback button present on most screens to create a trouble ticket (Note: If the feedback is course related, it is usually assigned to the appropriate instructor.)

Faculty-to-Student Ratios – The first step is to identify the critical types of faculty interactions to be offered and then to determine the demands those interactions will place on the assigned faculty. DAU estimates the faculty-to-student ratio during the course design. During the operational trial of the course, the ratio may be adjusted based on the actual demands on faculty time. If an instructor needs additional support, a second instructor and section can be established. It is critical to designate backup instructors so those assigned instructors can take a day off without impeding the progress of the course.

Cohorts vs. Rolling Admissions – The DAU environment allows courseware developers to set up courses in cohorts (all students within a section start at the same time) or rolling enrollment (students are enrolled in a section at any time as long the faculty member has an opening). Cohorts are used when it is critical to keep students progressing through the lessons at the same pace. For examples, cohorts are used when web-based training is combined with video teletraining and students must be prepared for scheduled video teletraining broadcasts. Rolling admissions are used when quick access to course materials is more important that keeping students moving at an assigned pace.

Defining the Course Structure

The OSS includes a hierarchical structure to support courseware delivery through the OSS. The course hierarchy contains the framework for the courseware. Currently, DAU has defined the default courseware hierarchy to contain Course, Lesson, TLO, and ELO levels. The courseware developer has the ability to configure lesson dependencies. The OSS supports only serial dependencies. Therefore, access to Lesson 2 can be dependent upon successful completion of Lesson 1. The ELO is designated as the question level where all test questions are entered. Currently, the OSS supports the following question types: multiple choice, all that Apply, matching, sorting, fill in the blank. The OSS provides the capability to create, modify, and delete tests. Tests can be defined at the course, lesson, TLO and ELO levels. The OSS supports the following test types: Normal Test – The normal test can exist at any level in the course hierarchy. Successful completion of this test generates a pre-defined email and marks the level at which the test is taken as complete. The courseware developer can define the number of attempts allowed and the passing grade. A test may be created at the course, lesson, TLO and ELO level of the course hierarchy. Only one test may exist at a given level. When defining a test, the courseware developer must provide a unique test number along with a unique title, passing grade, the number of attempts allowed, predecessor/required node, and predecessor/required test. The courseware developer has the ability to configure test dependencies. The OSS supports only serial dependencies. Therefore, access to the Lesson 2 test can be dependent upon successful completion of the Lesson 1 test. The courseware developer is restricted from creating a circular dependency. For example, the courseware developer cannot designate Test 1 dependent upon Test 2 if Test 2 is already dependent upon Test 1. By selecting a dependent test, the courseware developer indicates that the student cannot take the defined test until the predecessor/required test has been successfully completed.

Test Questions

The OSS provides the capability to create, modify, and delete test questions. The OSS supports the following question types: multiple choice, all that apply, matching, sorting, and fill in the blank. The system supports the inclusion of images within the test question or test choices. Images are integrated into the test application by embedding the image tag within the actual question or choice.

Deciding Which OSS Tools to Integrate

In deciding which of the OSS collaboration tools to integrate into the courseware, the courseware developer should be guided by the principle that student-to-faculty and student-to student interaction of all types is desirable in order to increase the potential means for learning. Therefore, DAU courseware should be designed for interactivity, i.e. to incorporate multiple methods of interaction. The following OSS collaboration tools are available for integration into courseware: News, Library, Forum, Calendar, Task, Glossary, FAQ, Email, and Chat.

Each course can include the following set of functional modules: News, Library, Forum, Calendar, Task, Glossary, FAQ, Email, and Chat. Feedback (email to the OSS System Administrator) is available at any time from the left-hand button bar. To prevent duplication of effort, access to the OSS course functional modules is available from within the courseware. The user will populate these modules using the administrative screens as described in Populating OSS Tools below. The courseware will then include links that allow the student to access the functional modules from within the courseware. A coding example for integrating the Glossary functional module within the courseware is as follows: <cfoutput> Glossary </cfoutput>

Populating OSS Tools

To support population of collaboration tools, bulk uploads are available at both the course and section levels. Bulk uploads are an alternative to manually populating the OSS tools using admin screens and forms. Course level uploads are used by the course administrator to provide course materials to all sections and by course instructors for their individual sections. Once course level entries are made, all sections that are created or started after the upload will inherit the information at the course level. Sections that already exist can inherit newly uploaded material by checking the inherit box. Section level loads are used by the instructor for providing information that is specific to their section. Section level uploads will be appended to the course information that was inherited by the section. Course and section uploads follow similar procedures and can be done for glossary terms, FAQ items, and library links.

There are five levels of privileges for each collaboration tool or function.

0 – No Access – No access to the associated function

1 = View Only – Access to view items within the associated function

2 = View & Edit – Access to view, create, and edit own created items within the associated function

3 = Limited Admin – Access to view, create, and edit items created by all users with View & Edit privilege, and to edit own created items within the associated function

4 – Admin Rights – Access to view, create, and edit any item within the associated function, regardless of the creator

The OSS contains multiple levels of information, including the DAU Public Website (public site), DAU Virtual Campus (private site), course level and section level. The reason for having multiple levels is to allow for information security and compartmentalization. In this way, users can only see the data to which they have been granted access. The course level is displayed when a user (other than a student) clicks on a course title link from the Home Desktop. The course level provides a course template for all sections of the course, and serves as the repository for course information. Course-related data is usually entered at the course level, in order to provide consistent information to all sections. At this level, instructors, course administrators and other authorized users can interact within the course environment. The section level is displayed when a user (other than a student) clicks on a section number link from the Home Desktop, or when a student clicks on a course title link. New sections inherit OSS data specified at the course level. Section-specific data is entered at the section level. At this level, all members of a particular course section (instructor and students) can interact within the section's virtual classroom environment.

Summary

The Defense Acquisition University virtual campus is a unique model for web based instruction because it integrates all aspects of managing a corporate university while providing myriad dynamic layers of access privileges. The OSS provides functionality in 16 main areas: DAU Public Website, Registration, Enrollment , Login , OSS User Types, OSS Collaboration Tools, Search , History, Logs, Reports, Canned Email, Feedback, Help, Courseware Interfaces, Test Application , and Database Interfaces. This paper has attempted to describe the functionality of the DAU's virtual campus. However, the virtual campus is best communicated through active demonstration and interactive dialogue.

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Management and Workflow of Electronic Documents using a 2^{nd}-Generation WWW-server

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Abstract: With the advancement of DTP and Digital Libraries a workflow exclusively based on electronic documents has started to become a viable alternative for a continuously growing community. Information is entered into a computer, forwarded to other people, reviewed, modified and finally stored, without ever using paper (as a transport medium) during this full life cycle.
In most cases dedicated software (Document Management Systems) is used to accomplish this digital form of information management. However, these systems are typically expensive, either too specialized or too complex, or they lack the ability to support their users in an Internet environment (ie. not connected to their home intranet).
We present a new approach to use a second generation WWW-server (*Hyperwave Information Server*) to manage access, storage and workflow of electronic multimedia documents. We achieve this goal by a combination of Hyperwave and other components that are available in most offices: office-tools, WWW-browsers and the Internet.
This design, presented in more detail later in this paper, is being implemented and evaluated in cooperation with the German Research Foundation (DFG), where our existing prototype is being used for the electronic submission and the subsequent handling of research grant applications.

1 Introduction

Today, the scientific community faces a lot of situations where the use of electronic documents (opposed to paper) bears a lot of advantages, for both the sender and the receiver of information.

Considering the paper submission process to conferences we frequently experience that, even in case of electronic submission, printouts are made and sent to the reviewers. Their (sometimes handwritten) comments are typed into a computer and finally the paper is printed and sent to the publisher. Another example (which is the focus of our research project *GoldenGate*, see Section 5) are applications for research funding. Grant applications are prepared and sent – typically on paper – to a funding agency. There, copies are produced for the reviewing process and for internal use. Additionally the key parameters of the grant proposal (such as the amount of funding) are extracted and stored in a database. At the end of the application process, several printouts are made, one informing the applicant(s) about the approval, others informing various departments of the funding agency (e.g. finances or public relations), to name just a few examples.

Of course, paper has some important advantages over a simple electronic file. These advantages have to be modeled as accurately as possible whenever attempting to replace workflows similar to those described above by their electronic counterparts. We will describe some of the key features and their typical implementation in Section 2. Section 3 introduces the Hyperwave Information Server, a second generation WWW-server, that combines several ideas from the worlds of databases and the World Wide Web. It is the basis for our new approach (described in Section 4), which is the central issue of this paper: combine Hyperwave, existing "standard" office-tools and Internet technologies to form an Information and Workflow Management System. In Section 5 we briefly present our research project "GoldenGate" as a proof of concept for our approach. We finally deal with some results and some future steps of this project in Section 6.

2 Common Features of Information Management Systems

A piece of paper with some important information sitting on a desk can only be read by a person present in that room. If the paper is locked away even that is impossible. What is even more important: only a person actually holding the paper in his hands can make changes or add comments.

On paper one can leave a signature to prove that the information has been processed or to authenticate approvals. Of course, both can be forged, but techniques and rules to (at least) minimize this risk are well known and well established.

Especially in administrative environments, predefined actions are associated with each document. When it is passed on, the next person in the process chain typically knows about the following actions to be performed before passing it on again or returning it.

These three features – access control, authentication, workflow – are the most important ones (besides storage) that Information Management Systems (IMS) have to implement. A transition from traditional work processes to their digital equivalent cannot be implemented with any of the above key features missing. Even more critical, experienced users will recognize problems in these areas well before starting to appreciate the advantages of electronic workflows.

Of course, electronic information management systems also include some – hopefully many – of the advantages that an electronic environment can offer: simultaneous access to shared documents from distributed locations, the automatic creation of full-text indexes including new documents at insertion time, (full-text) queries, to name just the most prominent ones.

The point we are trying to make is that a system implementing the key features discussed above resembles an Information (or Workflow) Management System, even if is not marketed or easily identified as such. In the following sections we describe such a system, its prototype implementation and first results of a typical real-life application.

3 Hyperwave Information Server

The *Hyperwave Information Server* [Kappe et al., 1993, Maurer, 1996] can be described as a second generation WWW-server combining a database and a web-server. It is based on modern concepts of database design and information retrieval as well as multimedia storage and Internet access.

Some of the relevant features exploited by our approach are:

- The integrated database stores any kind of (multimedia) data-object in one or several hierarchies of objects and collections of objects (which can contain collections themselves). In any case, the data is stored only once, several instances are modeled by reference.

  These references or "links" are database objects themselves and they are robust, meaning if you move or rename an object, all links remain valid.

- Any object can be described by arbitrary metadata, called "attributes". You can build indexes over these attributes to execute boolean or ranked queries.

- Every database object is access controlled with read, write and delete rights for single users, groups or everyone, similar to UNIX file-system rights.

- All these features can be used and even administrated via conventional WWW-browsers from anywhere of the world (given the proper access rights).

- Additionally, the full functionality can be used from other programs with the help of a TCP/IP protocol (Hyper-G Client-Server-Protocol [Hyperwave GmbH, 1997]).

- A full-text engine of Verity Inc. is integrated allowing full-text queries not only for "readable" data, but also for popular formats like Adobe Portable Document Format (PDF) [Bienz and Cohn, 1993], PostScript [Adobe Systems Inc., 1990] and several formats from the Microsoft Office suite.

In addition to the above, Hyperwave includes programmable (server-side JavaScript) layout templates, support for multilinguality and sequences of objects, stored queries, and gateways to other databases or user identification systems.

Hyperwave Information Server runs on several different hardware/software platforms, including such common ones as Microsoft Windows NT, SUN Solaris and SGI IRIX.

4 Modeling Information Management with Hyperwave

If modern Information or Workflow Management Systems (like *Lotus Notes Domino* [Lotus Devel. Corp., 1999], *InConcert* [InConcert Inc., 1999], *Texcel Information Manager* [Texcel International, 1999],... to name only a few commercial ones) already do implement the features described in Section 2, why follow a different approach? The answer in our case is that these software packages often have disadvantages, which are severe in some situations (and may be negligible in others).

Each current IMS consists of several components or interfaces, which can be grouped according input, output, access, storage and workflow. If these components are integrated into one complete system, everything works smoothly and efficiently together. However, problems arise when applications require the use of special input components that are not included in the integrated system.

Another problem often is individual worldwide access (Groupware, collaboration, communication), especially using the complete functionality, possibly without special client software.

Many research groups are working in these fields, stressing one or the other aspect. For example, the *Open Hypermedia Systems Working Group* (OHSWG) [OHSWG, 1999] tries to combine existing tools as components and to extend them with Hypermedia functionality. The *Basic Support for Cooperative Work* project (BSCW) at GMD [Bentley et al., 1997] concentrates on cross-platform group collaboration services based on existing WWW technologies. Also Web-based is *Endeavors* [U.C. Irvine, Information and Computer Science, 1999] from U.C. Irvine, which is a flexible lightweight workflow infrastructure that provides support for process specification, distribution and integration of third party tools.

Our approach can be characterized best by: take the software you already use for the input, output and handling of documents plus a Hyperwave server for the storage and workflow as the basic components and combine these using the Internet technology.

As a consequence, users continue to use their favorite office tools (e.g. Microsoft Excel and Word) to enter information and store it in the applications' native formats into the Hyperwave database, which can handle them as any other type of data. Everyone with an Internet connection, a web-browser and a tool to handle the data format can access the information in the database (from everywhere), provided proper access rights have been granted. As the information is stored in the tool's native format, users can use the same tools to extract, modify or output the documents.

Storage and access control is one of Hyperwave's basic features. Personalized users, in contrast to anonymous ones, hold an account with username and password. Fine grain access control allows detailed tuning of document access at the read, write, modify, or hyperlink level, with anonymous users only having access to public information.

A major advantage of the use of single standard components is that each improved version immediately improves the complete system. For example, input tool A can be replaced by the new release A+ most of the time without (expensive or unreliable) update of the overall system.

It is important to note, that, due to being fully programmable, common office tools are very flexible today. As a consequence, customization to individual demands with regard to user functionality or user settings can easily be accomplished. Such customizations will enable the various components not only to download or upload data but also to interact with Hyperwave servers. Components could store/modify metadata about documents, query for additional information or collect data from a hierarchy to build a new document (e.g. a statistical analysis within Microsoft Excel).

This feature is the key to the implementation of the final part of an information management package: the workflow. The basis for workflow management are processes and use cases. Someone enters a new document and opens a case for a specific process. A second person modifies the document, a third returns it to the second or perhaps closes the case. Such a process can easily be modeled by passing along proper access rights: while the first user creates the document this person is the only one with full access. When the document is passed on ("checked out"), a tool adapts access rights such that only the second person can work with and modify the data and so on. Hyperwave's collections and reference links can be used to have such tasks show up in special locations of the hierarchy with the recipient informed about the arrival either by email or by the result of a stored query (a Hyperwave feature).

This sounds like a lot of work. In fact, there is work to do, but significantly less compared to building a full system from scratch. According to our approach we only need to build the interfaces between the existing components, similar to inserting an integrated system into an existing environment. Considering that we build on top of office components already in use training with the new system can be kept to an absolute minimum and productivity won't be reduced by an adaption period.

In the next section we will describe an actual application of this approach that shows how the concept works in the "real world".

5 Proof of Concept: GoldenGate

GoldenGate is a joint research project of the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) and our group over a period of 3 years, that deals with the electronic submission, the managing and the approval of research grant proposals. DFG is the largest research funding agency in Germany and supports several thousand projects per year with a funding volume of about 1.2 billion US $.

The goal of this project is the design and prototype development of a complete electronic workflow for the handling of research grant proposals and subsequent funding. Proposals are submitted in electronic form by researchers and are stored and managed (e.g. made available to reviewers) in a database until the final approval. Up to now the DFG interacts with the outside world only by paper documents. Internally they currently use a monolithic and proprietary system (called "All-in-One") that has been installed about 10 years ago and that can only handle ASCII-documents.

The DFG acknowledges the need for a new, modern system, that can handle multimedia documents, is open to external users (e.g. reviewers) and is applicable for all departments. It also has to provide a modern user interface.

After carefully looking into DFG's internal structures and approval processes, we made the design decision to implement a new system based on the ideas described in the previous section.

The hardware basis are conventional PCs running Microsoft Windows NT. As software components – besides the Hyperwave Information Server – we chose Microsoft Office'97, because it is already used within the DFG for various office tasks, it is very common and it is complete as well as flexible. These components are combined using the Hyperwave TCP/IP protocol [Hyperwave GmbH, 1997], the Microsoft Component Object Model (COM) [Microsoft Corp., 1999] and a scripting language (Python [Rossum, 1995], but also Java and Perl were used). See Figure 1 for the structure of the complete system. All components are centered around the Hyperwave server which acts as address and application database. It is accessed by TCP/IP either directly (e.g. with a WWW-browser) or through our so called TCP/IP – COM interface which allows access from office tools.

We should also mention that a significant number of employees at DFG are not satisfied with the currently available system (based on 'dumb' VT-220 type terminals) as they have computers at home and have reached the level of computer literacy which enables them to compare available tools in the MS Office environment to the system running in their office. Considering the already available skills of these employees (a continuously growing group) the choice for MS Office was an obvious one.

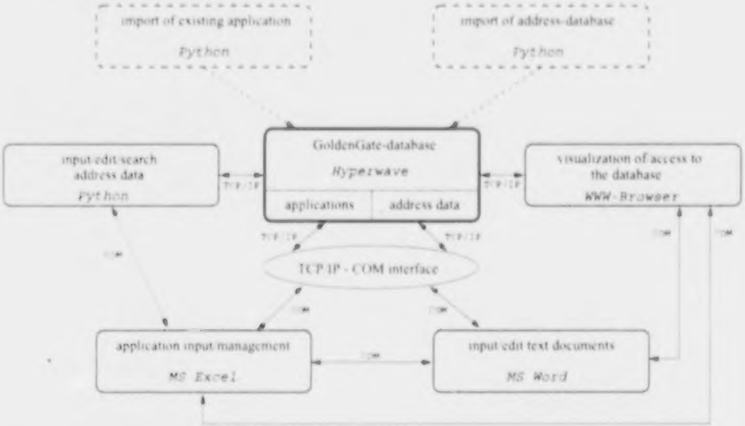
import of existing application
Python
import of address-database
Python
input/edit/search address data
Python
GoldenGate-database
Hyperwave
applications
address data
visualization of access to the database
WWW-Browser
TCP/IP
TCP/IP
TCP/IP
TCP/IP
TCP/IP - COM interface
COM
COM
COM
COM
COM
COM
application input/management
MS Excel
input/edit text documents
MS Word

Figure 1: The structure, components and communication channels of the current prototype implementation of GoldenGate.

The final system will allow a potential grant applicant to download (via HTTP) a template for his favorite word-processor (Microsoft Word, LaTeX, Adobe FrameMaker...) which includes support and help (e.g. by "wizards" and selections lists) when creating the application. The resulting (electronic) document is uploaded (again, via HTTP)

BEST COPY AVAILABLE

to the GoldenGate server at the DFG, where it is converted into an internal format (XML [W3C XML WG, 1997]) and stored in a special collection of the database hierarchy. Security can be easily guaranteed by the use of techniques like Secure Socket Layer (SSL) and/or Pretty Good Privacy (PGP). Of course, this list is likely to change over the lifetime of this project. As we base our design on standard components, we can easily exploit new features or new components as they become available.

At the DFG, the receiving side of grant proposals, a funding officer in charge is informed that a new research proposal has arrived. From this application, a "dynamic view" (a Microsoft Excel sheet) is generated automatically and also stored in the database. It is automatically referenced from other locations within the hierarchy of the DFG's intranet server, according to several thesauri. The electronic version of the proposal is also supplemented with metadata automatically extracted from the application. Those dynamic documents can then be checked, manipulated or passed on with Excel'97.

Many features of Excel like pop-up menus or forms support the user in a well known and intuitive way, e.g. during access to the agency wide address database or in the selection of standard entries in predefined lists. During this whole process, so called "static views" (currently Adobe PDF documents, but any other format can easily be supported) can be generated at any time to take a snapshot of a particular state of the process or to act as read-only documents for other departments or reviewers.

All the time, the document remains stored in Hyperwave's database hierarchy. This database can be browsed or queried with each individual's favorite Web-browser thereby granting non-standard retrieval procedures. For example, all proposals by person X or all approved applications in research field Y can be viewed (provided access rights do match) without explicitly supporting these types of retrievals as dedicated user functions. In case someone clicks on a dynamic view to work with it, the document is checked-out by granting the read/write access exclusively to this user until it is checked-in again.

Hyperwave's programmable templates, its internal locking mechanisms and CGI scripts are used to implement this behavior. In a nutshell: all this could easily be accomplished by features of the 2nd generation WWW-server Hyperwave (see Sec. 3).

6 Preliminary Results and Future Work

First evaluations at the DFG are very promising and show that the system meets its design goals with respect to flexibility and efficient extensibility. As a conclusion, our approach of combining Hyperwave and office tools by Internet technologies fulfills our expectations (see also below).

The larger part of the GoldenGate system as described in the previous section has already been implemented. A specific template for Microsoft Word'97 has been developed. The document that is created from this template is structured (and looks) like a conventional grant application when printed on paper. But when saved in *Rich Text Format (RTF)* and sent to the GoldenGate server, the essential information is automatically extracted and converted (via XML) to a Microsoft Excel'97 sheet. This is made possible by using some hidden markup in the template, that is parsed during the conversion step. We have created a XML DTD that allows us to check well-formedness and validity of the incoming data and possibly reject the input automatically. The Excel sheet allows the people in a DFG department to fulfill all typical tasks.

During first demonstrations and iterations we learned quickly that we had to increase our systems' abilities (which was not planned in the beginning) to provide a complete electronic workflow: support for letters and mail merges, storage for "other" documents and statistical analysis of elements in the database became necessary.

As a proof of concept – and without implementing additional modules – we could support the additional tasks by merely activating (i.e. giving users access to) built-in functionality of the underlying office tools. Now, Microsoft Word'97 is used to generate mail merges by accessing the address database on the Hyperwave server and to store arbitrary documents (another basic feature of Hyperwave). For the data analysis we just use the statistics components of Microsoft Excel (tables, bar graphs, pie charts…). Data has just to be grabbed from the attributes of the database hierarchy filtered through appropriate retrievals.

By the way, during this improvement process we made one of DFG's currently used software packages superfluous. Its whole functionality basically consisted of running mail merge. With the help of our approach several thousands of lines of code were replaced by something that – at least today – is already there and just had to be used.

The resulting prototype in its current form has, over several demonstrations and evaluations, shown that it works efficiently and reliably. Several departments at the German Research Foundation are interested in using it, because they are convinced that the amount of routine work can be significantly reduced with the help of GoldenGate.

We are now preparing the installation of the first operational system in one of DFG's departments to gather important information for our research. Of course, commercial partners will take care of the training, support, and running the hot-line.

At the moment we are still learning and analyzing the conventional processes and workflows at DFG. As those, like in most other large organizations, were never written down and nobody knows all of them, we have to use an iterative approach. Whenever we implement something new, people at DFG have new ideas and discover new possibilities how GoldenGate could help them. Up to now, we were able to realize those extra demands quite effortlessly.

Our future tasks are the systematic extension of the system to cover more steps in the process chain of reviewing and handling of grant proposals. Of course, the biggest challenge seems to be the automated assistance of end users in the desire to customize (or radically change) the look-and-feel of the individual user interface layouts ...

References

[Adobe Systems Inc., 1990] Adobe Systems Inc. (1990). *PostScript Language Reference Manual*. Addison-Wesley, 2 edition.

[Bentley et al., 1997] Bentley, R., Appelt, W., Busbach, U., and et al., E. H. (1997). Basic Support for Cooperative Work on the World Wide Web. *International Journal of Human Computer Studies: Special Issue on Novel Applications of the WWW*.

[Bienz and Cohn, 1993] Bienz, T. and Cohn, R. (1993). *Portable Document Format Reference Manual, Adobe Systems Incorporated*. Addison-Wesley.

[Hyperwave GmbH, 1997] Hyperwave GmbH (1997). Hyper-G Client-Server Protocol 7.17. http://www.hyperwave.de/7.17-hg-prot.

[InConcert Inc., 1999] InConcert Inc. (1999). Inconcert 2000 product data sheet. http://www.inconcertsw.com/solution/ic2000.htm.

[Kappe et al., 1993] Kappe, F., Maurer, H., and Sherbakov, N. (1993). Hyper-G: A universal hypermedia system. *Journal of Educational Multimedia and Hypermedia*, 2(1):39–66.

[Lotus Devel. Corp., 1999] Lotus Devel. Corp. (1999). Domino – family of servers. http://www.lotus.com/home.nsf/tabs/domino.

[Maurer, 1996] Maurer, H., editor (1996). *Hyper-G/now Hyperwave – The NEXT Generation WEB Solution*. Addison-Wesley, Harlow, England.

[Microsoft Corp., 1999] Microsoft Corp. (1999). The Component Object Model: Technical Overview. http://www.microsoft.com/com.

[OHSWG, 1999] OHSWG (1999). Open Hypermedia Systems Working Group. http://www.ohswg.org.

[Rossum, 1995] Rossum, G. v. (1995). Python reference manual. Technical Report 25, CWI, National Research Institute for Mathematics and Computer Science in the Netherlands.

[Texcel International, 1999] Texcel International (1999). Texcel information manager. http://www.texcel.no/im2pb.htm.

[U.C. Irvine, Information and Computer Science, 1999] U.C. Irvine, Information and Computer Science (1999). UCI Endeavors WWW-based Workflow. http://www.ics.uci.edu/pub/endeavors/endeavors.html.

[W3C XML WG, 1997] W3C XML WG (1997). Extensible Markup Language (XML) 1.0. http://www.w3.org/XML.

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From Information Management to Knowledge Management --Constructing the Digitized Learning Organization

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Abstract: In the post-capitalism era, the success of an organization lies more in it's knowledge and system capabilities than it's physical assets. Knowledge creation has become indispensable to industrial innovation and the improvement of the learning process in an organization. Therefore, this study reviewed the literature on knowledge creation and learning organization, and then drew on the " Knowledge Creating " model (Nonaka & Hedlund, 1994) for integrating it with the "processes of knowledge management", which was a new concept from this research. Furthermore, this research proposed a framework of a Digitized Learning Organization (hereinafter referred to as DLO) to further explore how to enhance the capabilities of learning and knowledge creation in a DLO. The ultimate goal of DLO is to become an environment with the atmosphere that would facilitate the learning activities of knowledge workers.

INTRODUCTION

The proper role of management is to ensure the application and performance of knowledge, that is, the application of knowledge, to knowledge itself. The creation and use of knowledge is a particular organizational challenge (Drucker, 1993). The purpose of this study is to depict the situations where an organization would make the most of knowledge. A conceptual model "Processes of Knowledge Management" is also developed, which is applied to the framework of DLO for facilitating dynamic changes of the environment. The section of implication deals with applying Knowledge Management to the DLO, introducing the basic framework of Knowledge Management as well as the concept of Knowledge Agent.

LITERATURE REVIEW: THE CONCEPT OF KNOWLEDGE

1. The definition of Knowledge

Drucker has called knowledge we know now consider proves itself in action. What we now mean by knowledge is information effective in action; information focused on results. These results are seen outside the person in the society and the economy, or in advancement of knowledge itself (Drucker, 1993). Hedlund and Nonaka have distinguished between three aspects of knowledge: cognitive knowledge in terms of mental constructs and precepts, skills, and knowledge embodied in products, well-defined services or artifacts (Hedlund and Nonaka, 1994).

First, the model distinguishes between tacit and articulated knowledge. The former is defined by Polanyi(Polanyi,1962), as a type of knowledge that is non-verbalized or even intuitive and unarticulated. The latter can be found either verbally or in writing, computer program, patents, drawing or the like. Second, the model distinguishes between four different types of knowledge carriers: the individual, the small group, the organization, and the inter-organizational domain. Tacit and articulated knowledge exist across all levels (Hedlund and Nonaka, 1994).

2. The Concept of Learning Organizations

Senge has warned that many organizations are unable to fully function as knowledge-based organizations, suffering from learning disabilities (Senge, 1990). To prevent such disabilities from happening, a number of organizations initiate a self-organizing network that is called as "a spider's web". Typically speaking, a spider's web brings people together as quickly to solve a particular problem as they disband once the job is done. Quinn indicated that this power of networking is so great that even with a modest number of collaborative independent professionals, a spider's web can leverage knowledge capabilities by hundreds of times (Quinn, 1996). The ultimate goal of the spider's web is to develop knowledge and information in continually generative and adaptive learning. The learning organization of the spider's web possesses information and knowledge that provide learners with a superb environment to maneuver with intelligence and creativity.

THE PROCESSES OF KNOWLEDGE MANAGEMENT

In this section, we attempt to present a conceptual model, an inductive one based on the observation we have made so far. It is also a model that we will employ to test more relevant hypotheses henceforth in our future research. The purpose of the model is to develop knowledge in continually profitable articulation and manifestations. To be more specific, the Processes of Knowledge Management include knowledge acquiring, knowledge transforming and knowledge distribution. (See Figure1)

The knowledge acquiring process is about the interpretation of news and messages received from the environment. People must choose information that they consider is significant to them, and base their explanation on the past experiences. Eventually they would negotiate on different views in order to arrive at a unanimous interpretation.

The conversion of knowledge accounts for the knowledge transforming process. People share their personal knowledge with each other through training, drill and apprenticeships. They articulate what they know intuitively through informal exchange as well as more official channels.

During the knowledge distribution process, the key activity is the processing of information about the available alternative in order to weigh their relative advantages and disadvantages. Nonaka and Hedlund claimed that an effective model of knowledge was developed. It builds on the interplay between articulated and tacit knowledge at four levels: the individuals, the small group, the organization, and the inter-organizational domain. People typically follow the sequence of steps and adopt a set of criteria to collect and manage knowledge (Hedlund and Nonaka, 1995).

All the processes--knowledge acquiring, transforming, and distribution --are being dynamic and subject to interruptions and iterations. The processes lead to changes of the environment, generating particular outcomes for the organization to adapt to. Another cycle has thus begun. The Processes of Knowledge Management offers a special advantage, allowing organizations to maneuver with intelligence and creativity.

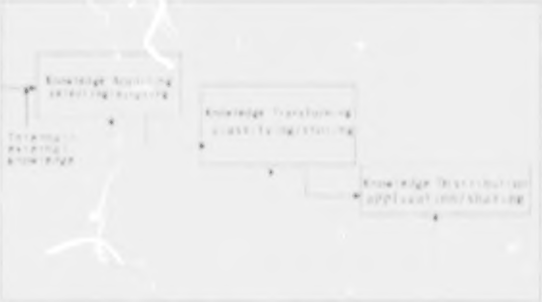

Figure1: The Processes of Knowledge Management

THE FRAMEWORK OF KNOWLEDGE MANAGEMENT IN THE DLO

Employing Knowledge Management (hereinafter referred to as KM) on the move of constructing a DLO has been given an unprecedented dimension especially in this knowledge-dominated era. As an overwhelming intelligence reservoir beyond doubt, a DLO is obliged to giving fuller play to its stored invaluable knowledge. Furthermore, it should enable users to be involved in the management level, and to share with each other any available feedback. Hence, the target mission of this implication is to elaborate on the concept of KM in terms of establishing a DLO with three distinct to-dos in mind. Firstly, to provide the audience with an open and interactive learning environment. Secondly, to allow room for the audience to perform management-related tasks. Lastly, to ensure the audience to be able to share with the DLO their knowledge, while offering their feedback.

The three most essential components of this framework include knowledge workers, knowledge repository, and they are able to interact with the other only through knowledge activities, as shown in the below Figure 2.

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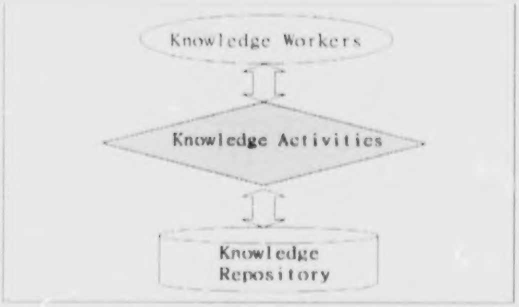
Knowledge Workers
Knowledge Activities
Knowledge Repository

Figure 2: Framework of KM in a DLO

1. Knowledge Workers

Those who carry out learning and management tasks are regarded as Knowledge Workers in a DLO. Being the sole active component in this infrastructure, they can be subdivided into three categories: learners, operators and officers.

2. Knowledge Repository

Being regarded as a passive element in the KM activities, it is in charge of compiling all the knowledge accumulated throughout the learning and management tasks by knowledge workers. Knowledge repository can be divided by their distinct nature further into three groups: the external knowledge, the structured internal knowledge and the informal internal knowledge (Davenport, 1998). On the other hand, in meeting the immediate demands of knowledge workers during any knowledge activities, this study distinguishes between learning knowledge repository and management knowledge repository, in the hope of enhancing the effectiveness and efficacy of the launching of learning and management tasks.

Learning knowledge repository refers to the knowledge that DLO has collected from knowledge workers in the course of their learning activities and can be categorized further into "feedback" and "service". The former has to do with opinion postings and open discussions, while the latter involves record-keeping on customers' behavior of inquiries, the in-person referral help offered by the instructors, the manufacturing of knowledge mapping, etc. The below figure 3 can be referred to for more details on this subject.

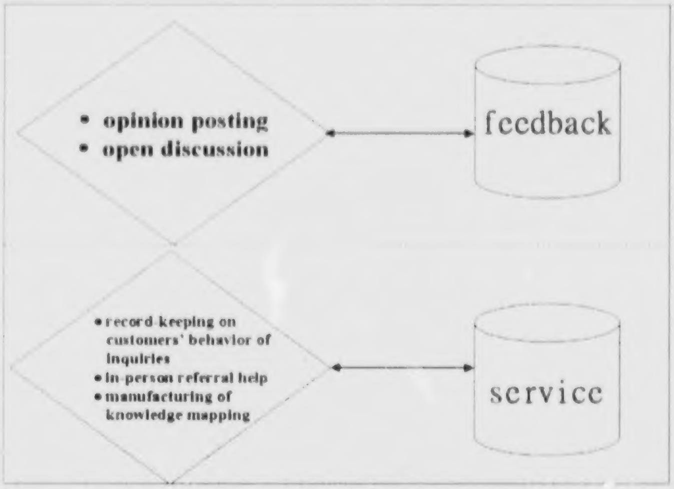
• opinion posting
• open discussion
feedback
• record-keeping on customers' behavior of inquiries
• in-person referral help
• manufacturing of knowledge mapping
service

Figure 3: Learning knowledge repository

On the other hand, management knowledge repository is related to the accumulated knowledge to which knowledge workers contribute what they learn from their management activities. It can be categorized further into "standard" and "collection ", as shown in figure 4 in the below.

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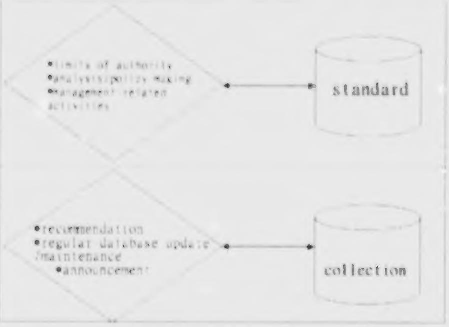

Figure 4: management knowledge repository

Standard has to do with the limits of one's authority, analysis/policy making, and management-related activities, while collection deals with ample room for recommendations, regular database update and maintenance, and announcements making, etc.

3. Knowledge activities

Can be divided further into "learning activities" and "management activities" by the nature of activity involved. The former has to do with the type of activity that is inspired and generated by knowledge workers' demand and interest. The latter is related to what knowledge workers dedicate themselves to for supporting and managing learning behaviors.

In addition, a term has been especially coined to propose proper proceeding entailed in any knowledge activity, which is "Processes of Knowledge Management" (Liou & Feng, 1998). The Processes of KM go from acquisition of knowledge, transformation of knowledge, and eventually, to the distribution of it, as exemplified in the previous Figure1.

The acquisition of knowledge results from the collecting and sampling of knowledge for learners by any DLO. To enable learners to make inquiries and to launch meaningful searches, the transformation of knowledge refers to classify and store knowledge in a systemic and consistent way. The final stage of this process of KM, namely the distribution of knowledge, makes clear that learners can eventually be assisted to apply their knowledge better and to conduct discussions as well as sharing of knowledge; meanwhile, learners also get to contribute their knowledge to the DLO in return.

In order to further clarify the framework of KM in a DLO, an Analysis Model is put forward to help formulate the initial stage of setting up a KM system in a DLO. This Model consists of Knowledge Agent, Use Case Model and Object Model. Herein we prioritize the discussion of Knowledge Agent rather than the other two. The reason for doing this is because it is a new concept introduced by this study and it has everything to do with knowledge workers (Fig.5) whose behaviors would in turn bring about a huge impact on the aforementioned framework of KM in a DLO.

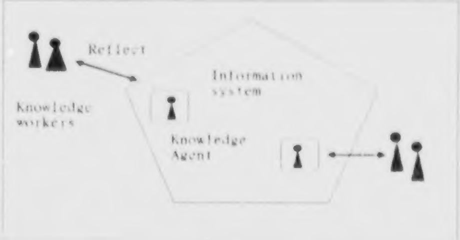

Figure 5: Relationship between Knowledge Agent and Knowledge Workers

More on knowledge workers

Prior to delving into the subject of Knowledge Agent, it is prerequisite and essential to develop the concept of knowledge workers better and introduce the knowledge structure in a DLO. According to Figure 6, it is self-evident that more sub-groups can be derived from the previous three types of knowledge workers, i.e. learners, instructors and managers.

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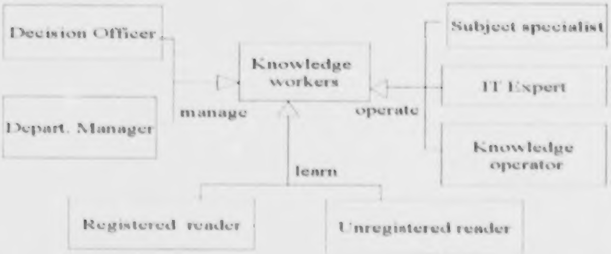
Decision Officer
Depart. Manager
manage
Knowledge workers
learn
operate
Subject specialist
IT Expert
Knowledge operator
Registered reader
Unregistered reader

Figure 6: Derivation of three types of Knowledge Workers

Note that knowledge workers work as a team, members of which are those that hold same or similar views toward certain things, and those whose knowledge work possess similar properties. They don't necessarily come from the same department in a DLO in order to be a team. Knowledge workers, before moving from one team to another as job demands, must know how to distinguish in the first place what job they are dealing with that suits the characteristic of the target team. This idea coincides with what Recipe Knowledge(Sackmann, 1991) has to offer.

Knowledge structure

Therefore, to analyze the knowledge structure in any DLO, we must first bear in mind that knowledge workers work as a team. Then, we induce and systematize a variety of Recipe Knowledge with the assistance of information technology in order to fit the KM mechanism seamlessly into the daily functioning of a DLO. (see Figure 7)

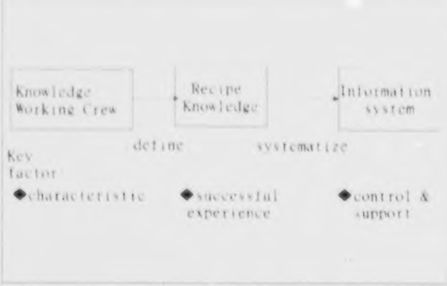
Knowledge Working Crew
Recipe Knowledge
Information system
define
systematize
Key factor
◆characteristic
◆successful experience
◆control & support

Figure7: Systematization of Knowledge Structure

Knowledge Agent

The conventionally inflexible bureaucratic levels in a DLO are subject to ossification, which smother workers' ability of innovation and self-improvement, despite the fact that it is an environment suitable for conducting the activities of knowledge acquisition and transfer. By putting forward the concept of Knowledge Agent, we accommodate a task-oriented departmentalization of the DLO for supplementing the lack of flexibility that the activity of knowledge dissemination can in effect benefit from. Knowledge Agent renders their service to team-based knowledge workers, supporting workers by offering them the necessary information

and management tools demanded by work. In addition, the below Table 1 further explicates the attributes and varieties of function carried out by Knowledge Agent.

Knowledge Agent	Service/support receiver	Attribute	Method
Officer Agent	Decision officer & depart. Manager in the Officer Crew	• Learning activity management; • Knowledge repository planning; • Comprehensive Information provider	• decision support system • on-line analysis tool • processes management tool • data access tool
Operator Agent	Subject Specialist, IT Expert & Knowledge Officer in the Operator Crew	• learning activity instruction • information framework development • standardized procedure establishment	• development tool of information system • classification & compilation tool • tool for management of limits of authority
Learner Agent	Registered & Unregistered readers in the Learner Crew	• interactive learning • assistance in participating management tasks • sharing & feedback	• means for inquiry- making • recommendation channel open for learners • means of discussion for learners

Table 1: Attributes & Functions in a Knowledge Agent

CONCLUSION

The impacts brought about by a DLO range from creative learning, cooperative learning, to constructive learning. Among the three, constructive learning is especially a crucial characteristic in learning organization. It highlights knowledge discovery and knowledge exploring, which is capable of converting articulated knowledge into tacit knowledge. A computerized system shall be proposed to support these three types of learning.

The only comparative advantage with the developed countries is in the amount of the supply of knowledge workers (Drucker, 1997). This in turn will enable new ways of learning, managing and creating knowledge. It will also lead to a generation with interconnected network, associated databases and technologies in collaboration.

The implication is about an attempt to have the KM mechanism connected with the day-to-day functioning of a DLO, in anticipation of a more open KM environment in this digital era by means of information technology. We have also explored in the first place how well the DLO is doing now to know where to improve on, prior to the use of the concept of KM.

REFERENCES

Argyris, C., & Schon, D. A. 1978. Organizational Learning. M.A.: Addison-Wesley.

Choo, C. W. 1996. "The Knowing Organization: How Organization Use Information to Construct Meaning, Create Knowledge and Make Decisions," *International Journal of Information Management* 16:5: 329-340.

Davenport, T. H. 1998. Working Knowledge. Boston: Harvard Business School Press.

Drucker, P. F. 1993. Post-Capitalist Society. New York: Harper Collins.

Drucker, P. F., & Senge, P. 1997. "Looking Ahead: Implications of the Present," *Harvard Business Review., Sep.-Oct.*, 18-32.

Hedlund, G., & Nonaka, I. 1994. "A Model of Knowledge Management and the N-Form Corporation", *Strategic Management Journal.*, 15, 73-90.

Hedlund, G., & Nonaka, I. 1995. "Models of knowledge management in the west and Japan." In P.

IBM. *IBM Intelligent Miner for AIX*. Germany: IBM.

Liou, W. C., & Feng, K. C. 1998. "The Framework of Digitized Learning Organization," in *The 7th International Conference on Computer-Assisted Instruction Proceedings, Kaoushiung, Taiwan*: 81-88.

Nonaka, I., & Takeuchi, H. 1995. The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York: Oxford University Press.

Polanyi, M. 1962. Personal Knowledge: Towards a Post-critical Philosophy. New York: Harper Torch Books.

Quinn, J. B. 1996. Managing Professional Intellect: Making the Most of the Best. *Harvard Business Review., March-April*, 71-80.

Sackmann, S. A. 1991. Cultural Knowledge In Organization: Exploring the Collective Mind. London: Sage Publications, 1991

Senge, P. M. 1990. The Fifth Discipline: The Art & Practice of the Learning Organization. New York: Doubleday Currency.

Internet Resources

Arizona University, "Creation of Meta Knowledge Base," Sep., 1998 http://a1.bpa.arisona.edu/papers/hicss25

Internet Public Library, "Electronic References Services," Aug., 1998, http://ipl.sils.umich.edu

OLAP Council, "OLAP and OLAP Server Definitions," Sep., 1998, http://www.olapcouncil.org/research/

On2broker: Semantic-based access to information sources at the WWW

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Abstract. On2broker provides brokering services to improve access to heterogeneous, distributed and semistructured information sources as they are presented in the World Wide Web. It relies on the use of *ontologies* to make explicit the semantics of web pages. In the paper we will discuss the general architecture and main components of On2broker and provide some application scenarios. We show how we can provide semantic based access to web sources described with HTML, XML, or RDF.

1 Introduction

Meanwhile, the World Wide Web (WWW) contains several hundred million static objects providing a broad variety of information sources. The early question of whether a certain piece of information is on the web has changed into the problem of how to find and extract it. Therefore, dealing with the problem of finding and maintaining information in the WWW has become a highly important topic and several initiatives exist that try to improve the current situation. Currently, most web sources relay on the use of *HTML* that describes structure (and layout) of documents, but not the semantics of the provided information. More recently, *XML* has been proposed that allows the definition of new tags (based on a DTD) that enable the semantic annotation of information (i.e., a tag *person* with subtags *name* and *telephone number* allows direct access to the provided information). Another web standard that is currently under development is the *Resource Description Framework RDF* [RDF] which allows the meta level annotation of web sources making their content explicit and machine processable. In addition to formalisms, standard vocabularies for describing information sources are developed by the *Dublin Core* and *MPEG-7* initiative.

In the paper we describe a tool environment called On2broker that processes information sources and content descriptions in HTML, XML, and RDF and that provides information retrieval, query answering and maintenance support. Central for our approach is the use of *ontologies* to describe background knowledge and to make explicit the semantics of web documents. Ontologies have been developed in the area of knowledge-based systems for structuring and reusing large bodies of knowledge (cf. CYC [Lenat, 1995], $(KA)^2$ [Benjamins et al., to appear]). Ontologies are consensual and formal specifications of vocabularies used to describe a specific domain. Ontologies can be used to describe the semantic structure of complex objects and are therefore well-suited for describing heterogeneous, distributed and semistructured information sources.

On2broker provides a broker architecture with four elements: a query interface for formulating queries, an info agent used for collecting the required knowledge from the web, an inference engine used to derive answers, and a database manager used to cache semantic annotations. On2broker uses semantic information for guiding the query answering process. It provides the answers with a well-defined syntax and semantics that can be directly understood and further processed by automatic agents or other software tools. It enables a homogeneous access to information that is physically distributed and heterogeneously represented in the WWW and it provides information that is not directly represented as facts in the WWW but which can be derived from other facts and some background knowledge. Still, the range of problems it can be applied to is much broader than information access and identification in semistructured information sources:

- *Automatic document generation* extracts information from weakly structured text sources and creates new textual sources. Assume distributed publication lists of members of a research group. The publication list for the whole group can automatically be generated by a query to On2broker. A background agent periodically consults On2broker and updates this page. The gist of this application is that it generates semistructured information presentations *from* other semistructured ones.

- *Maintenance* of weakly structured text sources helps to detect inconsistencies among documents and to detect inconsistencies between documents and external sources, i.e., to detect incorrectness (for example, a publication on a page of a member of the group must also be included in the publication list of the entire group). Again such a service can be provided by On2broker using its ontological representation language and inference engine.

The content of the paper is organized as follows. Section 2 discuss its core architecture and section 3 to 6 its elements. Finally, conclusions, related and future work are given in section 7.

2 The General Picture

The overall architecture of On2broker is provided in Figure 1 which includes four basic engines representing different aspects.

- The **query engine** receives queries and answers them by checking the content of the databases that were filled by the info and inference agents.
- The **info agent** is responsible for collecting factual knowledge from the web using various style of meta annotations, direct annotations like XML and in future also text mining techniques.
- The **inference engine** uses facts and ontologies to derive additional factual knowledge that is only provided implicitly. It frees knowledge providers from the burden of specifying each fact explicitly.
- The **database manager** is the backbone of the entire system. It receives facts from the Info agent, exchanges facts as input and output with the inference agent, and provides facts to the query engine.

Ontologies are the overall structuring principle. The info agent uses them to extract facts, the inference agent to infer facts, the database manager to structure the database and the query engine to provide help in formulating queries. A *representation* language is used to formulate an ontology. This language is based on Frame logic [Kifer et al., 1995]. Basically it provides classes, attributes with domain and range definitions, is-a hierarchies with set inclusion of subclasses and multiple attribute inheritance, and logical axioms that can be used to further characterize relationships between elements of an ontology and its instances. The ontology introduces the terminology that is used to define the factual knowledge provided by information sources on the web. A little example is provided in Figure 2. It defines the class *Object* and its subclasses *Person* and *Publication*. Some attributes are defined and some rules expressing relationships between them, for example, if a publication has a

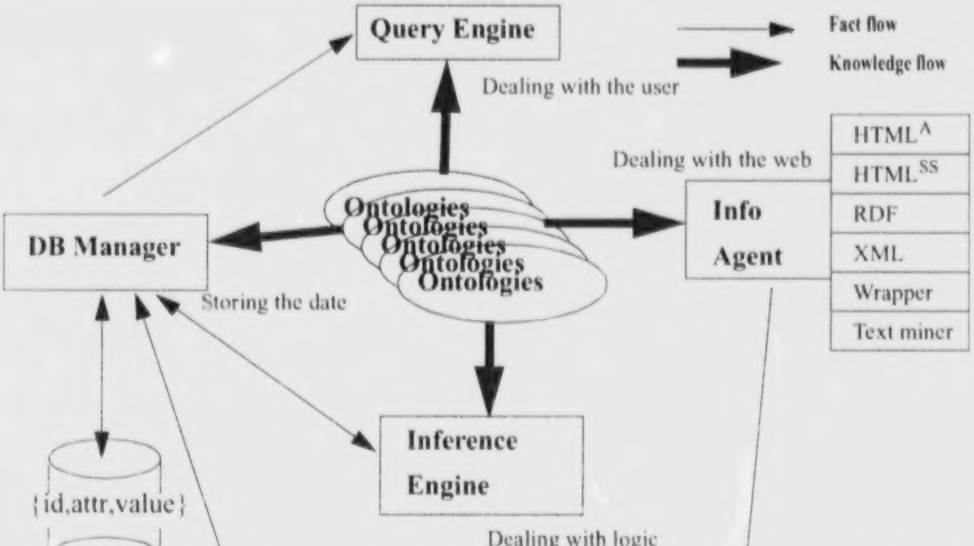

Figure 1 On2brokers Architecture.

```
Object[].
  Person :: Object.
  Publication::Object.
Person[
  Name =>> STRING;
  eMail =>> STRING;
  ...
  publication =>> Publication].
Publication[
author =>> Person;
title =>> STRING;
year =>> NUMBER;
abstract =>> STRING].
```

```
FORALL Person1, Person2
  Person1:Researcher [cooperatesWith ->> Person2]
 <-
  Person2:Researcher [cooperatesWith ->> Person1].

FORALL Person1, Publication1
  Publication1:Publication [author ->> Person1]
<->
 Person1:Person [publication ->> Publication1].
```

Figure 2 An excerpt of an ontology (taken from [Benjamins et al., to appear])

person as an author, then the author should have it as a publication.

3 The Query Engine

The *query* language is defined as a subset of the representation language. The elementary expression is:

$$x \in c \wedge attribute(x) = v$$

written in Frame logic:

x[*attribute* ->> *v*] : *c*

Complex expressions can be built by combing these elementary expressions with the usual logical connectives (∧, ∨, ¬). The following query asks for all abstracts of the publications of the researcher „Richard Benjamins".

x[*name* ->> „Richard Benjamins"; *publication* ->> {*y*[*abstract* ->> *z*]}] : *Researcher*

The variable substitutions for *z* are the desired abstracts. Expecting a normal web user to type queries in a logical language and to browse large formal definitions of ontologies is not very practical. Therefore, we exploited the structure of the query language to provide a tabular query interface and a quick and easy navigation is provided by a presentation scheme based on Hyperbolic Geometry [Lamping et al., 1995] (see Figure 3, and for more details [Fensel et al., 1998a]). Based on these interfaces, On2broker automatically derives the query in textual form and presents the result of the query.

In the effort to create efficient search mechanisms in the WWW, information *mediators*, the like of Metacrawler, and softbots (cf. [Etzioni, 1997]) that access other search engines will become increasingly important. That is why in On2broker the decision was taken to implement the query interface as an Java^{TM} *Remote Method Invocation (RMI) Server*. This allows us to make the Java^{TM} interface publicly available and thus give meta search engines more efficient access to the knowledge base.

4 The Info Agent

The info agent extracts factual knowledge from web sources. We will discuss the four possibilities we provide in On2broker.

First, we developed a small extension of HTML called HTML^{A} to integrate semantic annotations in HTML documents. On2broker uses a *webcrawler* to collect pages from the web, extracts their annotations, and parses them into the internal format of On2broker. More details on HTML^{A} can be found in [Decker et al., 1999].

Second, we use wrappers for automatically extracting knowledge from web sources. Annotation is a declarative way to specify the semantics of information sources. A procedural method is to write a program (called *wrapper*) that extracts factual knowledge from web sources. Writing wrappers for stable information sources enable us to

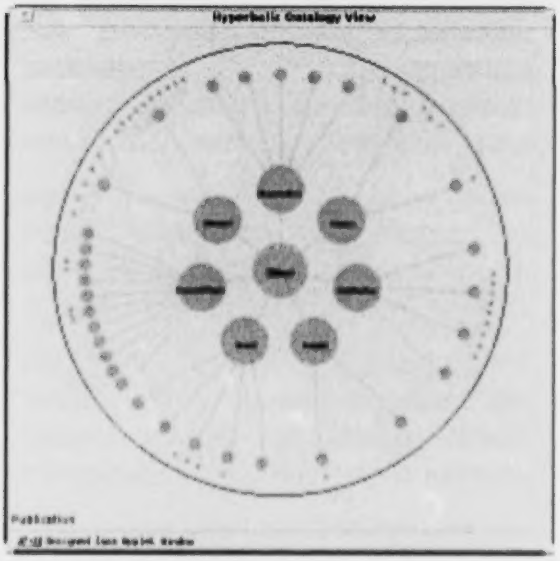

Figure 3 The hyperbolic ontology view.

apply On2broker to structured information sources that do not make use of our annotation language. In fact, we applied On2broker to the CIA World Fact book [CIA]. This shows that it is already possible to exploit structure and regularity in current web sources (i.e., HTML documents) to extract semantic knowledge from it without any additional annotation effort.

Third, On2broker can make use of RDF Annotations (cf. [Lassila & Swick, 1998]). Manually adding annotations to web sources requires human effort causing costs in terms of time and money. However, this annotation effort may become less problematic by spreading it over the entire web community. Currently the Resource Description Framework (RDF) [Lassila & Swick, 1998] arises as a standard for annotating web sources with machine-processable metadata. *RDF* provides means for adding semantics to a document without making any assumptions about the internal structure of this document. The info engine of Onto2broker can deal with RDF descriptions. We make use of the RDF Parser SiRPAC that translates RDF descriptions into triples that can directly be put into our database. More details on how our inference engine works with RDF are given in [Decker et al., 1998]. The inference engine of On2broker specialized for RDF is called *SiLRI (Simple Logic-based RDF Interpreter)*. Actually, On2broker is the first inference engine for RDF.[1]

Fourth, another interesting possibility is the increased use of the eXtensible Markup language XML. In many cases, the tags defined by a DTD may carry semantics that can be used for information retrieval. For example, assume a DTD that defines a person tag and within it a name and phone number tag.

<PERSON> <NAME>Richard Benjamins</NAME> <PHONE>+3120525-6263</PHONE> </PERSON>

Then the information is directly accessible with its semantics and can be processed later by Ontobroker for query answering. Expressed in Frame logic, we get:

url[NAME ->> „Richard Benjamins"; PHONE ->>+3120525-6263] : PERSON

RDF still requires the annotation effort for creating metadata but this effort is now shared by the entire web community. XML provides the chance to get metadata „for free", i.e. as side product of defining the document structure. XML allows the definition of new tags with the help of a DTD and provides semantic information as a by-product of defining the structure of the document. A DTD defines a tree structure to describe documents and the different leaves of the tree have tags that provides semantics of the elementary information units presented by them. That is, the structure and semantics of a documents are interleaved. On2broker is able to read such DTD, to translate it into an ontology, and to translate XML documents into its internal triple representation. Actually, DTDs are serialized and simple means for describing ontologies. The above given example corresponds to a class

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[1] http://www.w3.org/RDF, RDF Software and Products.

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Person with two attributes *Name* and *Phone*. Weaknesses of DTDs from an ontological point of view are:

- No inheritance is provided. Therefore attribute definitions need to be repeated. If classes like *Person*, *Employee*, and *Student* share the same attributes their definition must be repeated for each class making maintenance difficult. In our approach, they can be defined for *Person* and inherited by *Employee* and *Student*.
- DTDs do not provide means to define the range of attributes, i.e. to constrain the values a tag may have.
- DTDs do not provide rules that allow the implicit representation of data. All data need to be represented explicitly (i.e., materialized).

5 The Inference Engine

The *inference engine* takes the facts collected by the webcrawler together with the terminology and axioms of the ontology, and then derives the answers to user queries. To achieve this it has to do a rather complex job. First it translates Frame logic into Horn logic via Lloyd-Topor transformations [Lloyd & Topor, 1984]. Techniques from deductive databases are applicable to implement the second stage: the bottom-up fixpoint evaluation procedure. We have adopted the well-founded model semantics [Van Gelder et al., 1991] and compute this semantics with an extension of dynamic filtering [Van Gelder, 1993].

The inference engine is used to derive information that is implicitly present in web sources without requiring that all information is complete materialized by annotations. We will briefly illustrate this with some examples.

(1) Employee :: Person

This is-a relationship implies that each employee is also a person and each attribute that is defined for persons can also be applied to employees.

(2) X [cooperates ->> Y] -> Y[cooperates --> X]

This rule ensures symmetry of cooperation. If it is known from an annotation that *Motta* cooperates with *Chandrasekaran* than we already know that *Chandrasekaran* cooperates with *Motta*, even if *Chandrasekaran* does not explicitly annotate his homepage with this fact.

(3) X [author ->> Y] : Publication -> Y[has-publication ->> X] : Researcher

The final example states that if in a publication file somebody is stated as author, we will get this publication if we query his homepage for his publications.

Without such an inference mechanism, the provided information is notoriously incomplete and annotation effort is unmanageable high.

6 The Database Manager: Decoupling Inference and Query Response

In the design of Ontobroker (cf. [Fensel et al., 1998a]) we already made an important decision when we separated the web crawler and the inference engine. The web crawler periodically collects information from the web and caches it. The inference engine uses this cache when answering queries. The decoupling of inferencing and fact collection is done for efficiency reasons. The same strategy is used by search engines on the web. A query is answered with help of their indexed cache and not by starting to extract pages from the web. On2broker refines this architecture by introducing a second separation: *separating the query and inference engines*. The inference engine works as a demon in the background. It takes facts from a database, infers new facts and returns these results back into the database. The query engine does not directly interact with the inference engine. Instead it takes facts from the database:

- Whenever inference is a time critical activity, it can be performed in the background independently of the time required to answer the query.
- Using database techniques for the query interface and its underlying facts provides robust tools that can handle mass data.
- It is relatively simple to include things like truncation, term similarity and ranking in the query answering mechanism. They can now directly be integrated into the SQL query interface (i.e., in part they are already provided by SQL) and do not require any changes to the much more complex inference engine.

The strict separation of query and inference engines can be weakened for cases where this separation would cause disadvantages. In many cases it may not be necessary to enter the entire minimal model in a database. Many facts are of intermediate or no interest when answering a query. The inference engine of On2broker incorporates this in its dynamic filtering strategy which uses the query to focus the inference process (cf. [Fensel et al., 1998b]).

7 Conclusions

On2broker is the successor system of Ontobroker (cf. [Fensel et al., 1998a], [Decker et al., 1999]). The major new design decisions in On2broker are the clear separation of query and inference engines and the integration of new web standards like XML and RDF. Both decisions are answers to two significant complexity problems of Ontobroker: the computational inference effort for a large number of facts and the human annotation effort for adding semantics to HTML documents. On2broker is available on the web and has been applied in a number of applications in the meantime. The most prominent one is the $(KA)^2$ initiative that provides semantic access to all kinds of information of research groups of the knowledge acquisition community [Benjamins et al., to appear].

The use of *one* ontology for annotating web documents will never scale up for the entire web. Neither will an ontology be suitable for all subjects and domains nor will ever such a large and heterogeneous community as the web community agree on a complex ontology for describing all their issues (like there will be not one DTD for all purposes). Therefore, work on relating and integrating various ontologies will become an interesting and necessary research enterprise which will also be addressed in the future course of the On2broker project.

References

[Benjamins et al., to appear] R. Benjamins, D. Fensel, S. Decker, and A. Gomez Perez: Knowledge Management Through Ontologies. To appear in the *International Journal of Human-Computer Studies (IJHCS)*.

[CIA] http://www.odci.gov/cia/publications/factbook.

[Decker et al., 1998] S. Decker, D. Brickley, J. Saarela, and J. Angele: A Query and Inference Service for RDF. In *Proceedings of the W3C Query Language Workshop (QL-98)*, Boston, MA, December 3-4, 1998.

[Decker et al., 1999] S. Decker, M. Erdmann, D. Fensel, and R. Studer: Ontobroker: Ontology based Access to Distributed and Semi-Structured Information. In R. Meersman et al. (eds.), *Semantic Issues in Multimedia Systems*, Kluwer Academic Publisher, Boston, 1999.

[Etzioni, 1997] O. Etzioni: Moving Up the Information Food Chain, *AI Magazine*, 18(2), 1997.

[Fensel et al., 1998a] D. Fensel, S. Decker, M. Erdmann, and R. Studer: Ontobroker: The Very High Idea. In *Proceedings of the 11th International Flairs Conference (FLAIRS-98)*, Sanibal Island, Florida, USA, 131-135, Mai 1998.

[Fensel et al., 1998b] D. Fensel, J. Angele, and R. Studer: The Knowledge Acquisition And Representation Language KARL, *IEEE Transactions on Knowledge and Data Engineering*, 10(4):527-550, 1998.

[Van Gelder, 1993] A. Van Gelder: The Alternating Fixpoint of Logic Programs with Negation, *Journal of Computer and System Sciences*, 47(1):185—221, 1993.

[Van Gelder et al., 1991] A. Van Gelder, K. Ross, J. S. Schlipf: The Well-Founded Semantics for General Logic Programs, *Journal of the ACM*, 38(3): 620—650, 1991.

[Kifer et al., 1995] M. Kifer, G. Lausen, and J. Wu: Logical Foundations of Object-Oriented and Frame-Based Languages, *Journal of the ACM*, 42, 1995.

[Lamping et al., 1995] L. Lamping, R. Rao, and Peter Pirolli.: A Focus+Context Technique Based on Hyperbolic Geometry for Visualizing Large Hierarchies. In *Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems*, 1995.

[Lassila & Swick, 1998] O. Lassila and R. R. Swick (eds.): Resource Description Framework (RDF) Model and Syntax Specification, *W3C Working Draft*, August 19, 1998. http://www.w3c.org/TR/WD-rdf-syntax.

[Lenat, 1995] D. B. Lenat: CYC: A Large-Scale Investment in Knowledge Infrastructure, *Communications of the ACM* 38(11), 1995.

[Lloyd & Topor, 1984] J. W. Lloyd and R. W: Topor: Making Prolog more Expressive, *Journal of Logic Programming*, 3:225-—240, 1984.

[RDF] http://www.w3c.org/Metadata. See http://www.w3c.org/RDF.

Web Centric Education -
a Challenge for Process Redesign

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Abstract: The fusion of computer and communications technology is giving rise to many novel developments in computer-based education and distance learning. Evolving web centric learning environments are challenging current modes of working in traditional universities. Over the last decade, higher education has been subjected to immense pressures for change. The massive increase in student numbers coupled with reduced levels of funding, lead many to the belief it is essential that new and innovative modes of teaching and learning are adopted. But how innovative are current uses of technology? Are present web centric environments not merely an electronic image of the traditional framework? As higher education finds itself moving towards a commercial market where it could be subject to commercial forces, it would seem reasonable to examine the impact of information technology on education using the same models adopted to evaluate its impact within commercial organisations. This paper draws together current developments in computer-based education with concepts from business process re-engineering.

1. Introduction

In the period from 400BC when Plato's Academy was established outside Athens to teach philosophy, mathematics and gymnastics, until the present day, the mode of the educational process has been remarkably stable. The idiom has essentially consisted of a small number of teachers delivering material to a larger number of students. This is true both for face-to-face learning and also for distance learning. As in Plato's time, there has been much more emphasis on the face-to-face approach while the numbers involved in the process – both teachers and students – have been strictly limited.

Distance learning approaches, and more recently computer based education (CBE) and computer aided learning (CAL) environments, have started to disturb the balance that has existed since Hellenist times. The introduction of IT and a business ethos to the educational process has given rise to pressures similar to those experienced in commerce, with a focus on customer needs and whether the organisation can efficiently meet these needs. Education is rapidly evolving from an opportunity that is provided mainly for an elite, to one that is available to a mass market and which is therefore prone to the forces generated by such an environment. Where, in the established pattern, commercial interest was limited mainly to the use of skills developed during the educational process, the future model of educational provision will involve extensive commercial activity in the production, delivery and marketing of material. Already there are a number of commercial companies offering framework products enabling "off the shelf solutions" for the construction and delivery of web based courses in any subject area. The commercialisation of education is underway and it is inevitable that entrepreneurs and customers will view it as any other commercial product. The commercial approach to education is emerging at a time when many business organisations are restructuring their operations to optimise use of IT. Such restructuring provides a clear pattern for changes within education.

2. Re-engineering - the models

Models for business change form a spectrum of approaches ranging from radical restructuring to evolutionary improvement. Their common purpose is that they aim to increase competitive edge by aligning business organisation with communications and information technology. A combination of radical and evolutionary paradigms is used to characterise business process restructuring [Venkatraman 1991]. This incorporates the ideas of business process re-engineering (BPR) [Hammer 1993] and identifies several stages in the evolution of IT based organisations. These stages operate at two separate levels. At the progressive level, the changes are of limited consequence to the organisation of a business whilst at the radical level, changes are incompatible with pre-existing business structures [Figure 1]. In general, an organisation will complete the sequential steps at the progressive level before proceeding to the independent changes at the radical level.

The initial stage in the restructuring process is characterised as localised exploitation of IT developments. Exploitation may impact business activities themselves or the administrative operations that support such activities. The use of IT may be tactical or strategic. Examples of such activities include the use of knowledge-based tools to support diagnosis of faults in electronic systems and the use of data mining techniques to focus marketing exercises. The significance of development at this level is that IT is exploited in discrete niches that provide business advantage. There is no coherence across an organisation in its approach to the use of IT.

The integration of IT activities across an organisation using a communications network represents the second stage of process restructuring. This stage is dependent on the existence of several computerised processes of the kind characterised by the localised exploitation stage. The benefits of this stage include greater integration of different functions within the business process and ready access by management to data describing the performance of the operation. Intranet development provides an organisation with a capability to operate at this level.

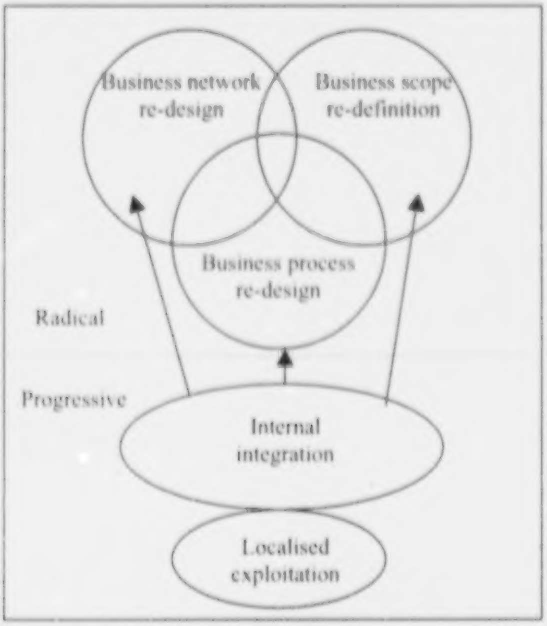
Business network re-design
Business scope re-definition
Business process re-design
Radical
Progressive
Internal integration
Localised exploitation

Figure 1: IT capability dependencies in the stages of business restructuring (after [Venkatraman 1991])

Within the radical stages of restructuring, business process re-design encapsulates the developments required in the organisation of commerce needed to provide major gains in the efficiency of business enterprises in response to IT investment. The technique involves fundamentally restructuring the ways in which a business operates to replace rigid product orientation.

The input to the re-engineering process is a system of business organisation that developed between the industrial revolution and the middle part of the 20th century. The system was focussed on functional decomposition and dealt well with limited product demand. The desired output from the re-engineering process is an improved level of product or service achieved at an expense that is a fraction of the costs before re-engineering. Asynchronous communication supported by IT provides the means for ensuring that activities that could only be accomplished by specialists in the functional decomposition paradigm can be accomplished by generalists in the re-engineered process or can be avoided altogether.

Development of Internet capabilities has done much to simplify the business network redesign stage of process restructuring. The use of such technology provides a basis on which co-operative processes involving discrete organisations can be constructed. Typical of this is the process of a manufacturer providing its suppliers with access to inventory levels with the understanding that the supplier would be responsible for delivering materials to re-supply inventory items at appropriate times. Both parties gain business advantage in such an arrangement. The supplier is able to optimise production and at the same time, the consumer is guaranteed that inventory is maintained at the most appropriate level.

The fifth level of business process re-engineering comprises developments in the types of business activities that an organisation conducts in response to perceived marketing opportunities. Examples may arise from business-critical applications that are developed by the organisation to solve specific problems and which are, in themselves, viable products. A typical example of such a change in focus is the development of MRP by General Motors. Initially conceived as an in-house system for supporting manufacturing of vehicles, this was later marketed as a product in its own right.

Despite the promises of BPR, it is difficult to show improvements in productivity as a consequence of increased investment in information technology infrastructure [Brynjolfsson, 1998]. Traditionally, major advances in productivity have coincided with the development of general-purpose technologies but significant changes in organisation have been required to maximise the benefit of these technologies. The replacement of steam engines by electric power was most successful where a single large steam engine was replaced by several smaller electric motors that provided power where it was required. It is not surprising that given the difficulty of demonstrating consistent productivity improvements generated by IT investment, most managers cite improvements in customer service and quality above cost savings as motivation for making investments in IT.

3. CBE – evolution and revolution

Computer technology has made a significant impact in many areas of teaching and learning. The introduction of desktop computers, word-processing packages and presentation preparation tools have improved greatly the quality of the material presented to students and used in lectures. The use of simple database packages and spreadsheets has improved and simplified record keeping at all levels within education. However, perhaps the most significant impact has come from the use of supportive learning mechanisms such as CAL and computer based training (CBT). These technologies make use of various forms of interactivity to engage the student in effective, and often novel, learning experiences.

Viewed from a business process re-engineering model all of these activities fall within the early or progressive stage of IT implementation, characterised by the local exploitation of technology to improve, in the main, the efficiency of the traditional legacy activities within the organisation.

The introduction of high-speed communication networks in the early eighties followed by the development of simplified and standardised access and presentation software in the form of web browsers, in the nineties, has enabled the easy sharing of information within organisations (via Intranets) and externally (via the Internet). Arguably, educational institutions have grasped this phase of IT development more than industry and commerce. Academics were quick to see the potential of the World Wide Web and web technology as a means of retrieving and sharing information. Intranets and the Internet now form the IT platforms in many academic institutions for the integration of many teaching and auxiliary activities: access to publicity material, course records and regulations, minutes of committees, course notes, on-line assessments and CAL animated simulations. The list is extensive and growing. Nearly all legacy activities offered by the faculty, or the institution as a whole, can be made available within and outside the organisation, using web-based technology.

At this stage of IT adoption, development has gone beyond individual activities exploiting their isolated IT applications and the integration of the institution's needs is now being handled through the shared IT platform. The fundamental processes however, remain basically unchanged: the university continues to carry out its basic activities - registration, lectures, assessment etc., as before but has made full use of the IT infrastructure. Completion of this stage marks the end of the progressive phase of IT adoption; the organisation has evolved, and through incremental change has adopted the use of the IT platform across its various activities.

The next phase of BPR development is characterised by a radical change in the way an organisation operates. In this phase, new technology enables a completely fresh approach to achieving the organisation's goals and does not simply provide support for the existing legacy operations. Business process redesign for education would involve not merely an improvement of existing practices, such as better CAL software or better multimedia presentations at lectures, but also, and more fundamentally, a reappraisal of the existing practice and a search for new and more efficient methods of achieving the organisation's goals [Mandviwalla 1998].

One area where teaching and learning practices are being re-examined is the implementation of distance learning courses delivered making use of technology based on the Internet, i.e. the Virtual University. Within this structure the technology is fully exploited to provide an environment where students can perform all their work remotely - accessing lectures from the home, tutorial discussions through news groups or on-line conferencing mechanisms, learning in a simulated environment, accessing a wide variety of information over the Internet. In the virtual university certain kinds of behaviour are encouraged and enabled. For example it is easy to communicate on a wide front, to search libraries and vast quantities of information, and to copy material. These capabilities have much to offer promoting student centred activity. However, they also have the potential to severely threaten aspects of quality as viewed from the conventional academic framework [Ferguson, McGettrick, and Smeed 1999].

While on the surface the virtual university concept might appear radical and a candidate for stage three in the BPR framework, close investigation does not show a fundamental shift from the basic legacy teaching and learning processes that are associated with traditional universities. The virtual lecture theatre, virtual coffee shop, assessment engines etc., are all parodies of processes within the traditional system.

4. Process redesign

Currently, traditional university learning is teacher centred. Within a virtual university the focus will shift from the teacher to the student. Inevitably, new approaches are required to produce materials that invite sustained study and examination. The role of the teacher will change to deal with the functions of evaluation and monitoring of distant learners as well as the author of material suitable for independent study. Incidentally, changes in the mechanisms of teaching delivery cast requirements for new techniques that ensure originality of work and protect against plagiarism and misuse of copyright.

Opportunities may develop for activities that have proven difficult to implement in traditional curriculum design. For example, many curricula seek to highlight common themes or lateral links between traditional, but separately taught topics or courses. It may be possible to ensure that these important keystones are highlighted to the student across what may appear to be totally disparate topics.

A number of emerging techniques offer radical enhancement to Web-based teaching. In particular, the need for dynamic control, annotation and interlinking of content can be addressed through recent developments. A key to all such ventures is a move away from manual organisational techniques toward automated management. The limited effectiveness of conventional Web-search and association facilities will soon be superseded by powerful context-sensitive trawling and data-mining approaches (cf. [Brin and Page 1998] and [Chakrabarti et al 1999]). Localised control of dynamic annotation may be secured through use of a Web-based software intermediary (e.g., as proposed in [Weir and Lepouras 1998]). Finally, the existence of fellow learners in similar but remote contexts promises the prospect of new supportive and co-operative learning opportunities [Kumar et al 1998].

Whatever the impact of such developments, there is a need to re-examine the basic processes on which current education is based and to be prepared to re-engineer the system to make maximum advantage of the opportunities provided by new technology.

5. Conclusion

The development of a mass market in education is leading to the commercialisation of the process and a decreasing emphasis on face-to-face teaching methods in favour of distance learning and especially distance learning supported by CBE.

The parallels between business process re-engineering and IT investment in industry and the development of computer based education suggest that the fundamental benefit which can be sought by the introduction of technology is improvements in product quality and customer service. In view of the significant investment required to produce good quality educational material, it is important that there is some form of measurement of the improvement that such systems generate. Without this quantification of benefit, it will be increasingly difficult to justify continuing investment in CBE development

There is a lack of overwhelming evidence that business process re-engineering consistently produces commercial benefits although there are isolated cases where this is so. While re-engineering in business has been progressing for almost a decade, education is only now being drawn into the process. Both business and education face major challenges in attempting to capitalise on the opportunities presented by IT in re-organisation.

References

Brin, S. & Page, L. (1999). Dynamic data mining: exploring large rule spaces by sampling, Paper No. 261, Department of Computer Science, Stanford University.

Brynjolfsson, E. & Hitt, L.M. (1998). Beyond the productivity paradox, *Communications of the ACM* vol.41, Part 8, pp. 56-62.

Chakrabarti, S., Dom, B.E., Gibson, D., Kleinberg, J., Kumar, R., Raghavan, P., Rajagopalan, S. & Tomkins, A. (1999). Mining the link structure of the World Wide Web, *IEEE* Computer.

Ferguson, J.D., McGettrick, A.D. & Smeed, D.N. (1999). Quality Issues in a Virtual University, in *Proceedings of CATE'99*.

Kumar, R., Raghavan, P., Rajagopalan, S. & Tomkins, A. (1999). Trawling the web for emerging cyber-communities, *8th WWW conference*, Toronto, Canada.

Hammer, M. & Champy, J. (1993). *Reengineering the corporation: a manifesto for business revolution* (London: Nicholas Brealey Publishing).

Mandviwalla, M. & Hovav, A. (1998). Adapting business process redesign concepts to learning processes, *Business Process Management Journal*, Vol.4, No.3, pp186-203.

Venkatraman, N. (1991). IT-induced business reconfiguration, in *The corporation of the 1990's*, ed M. S. Scott Morton, pp. 122-158. New York, NY: Oxford University Press.

Estimating the Number of Defects at a WWW Site

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Abstract: It is widely accepted that a high proportion of Web sites are poorly designed and suffer from a range of defects that affect both their usability and quality. Further, it has been postulated that failure to address this issue could lead to user rejection and a possible downturn in Web growth. The introduction of new Web authoring tools will help towards alleviating some problems at the design stage. However, despite these tools, any site of reasonable complexity will contain defects affecting its overall quality and usability. This paper presents an analysis that outlines several statistical models for estimating the number of defects at a Web site, providing a significant step forward in its appraisal and progress to improved reliability and quality.

1. Introduction

Recent forecasts have suggested that the current estimate of 4 million web sites will have grown to 200 million by the year 2003 [Nielsen 1999]. However, there is no indication that this rapid growth in site numbers will be accompanied by improvements in either their usability or quality. The profusion of badly designed and difficult to use sites is already prompting many to question the relevance of the Web for applications where quality is a major issue.

Education is one key area where quality is recognised as fundamental. The rapid growth in web-centric environments, characterised by the concept of the virtual university, have opened many new opportunities in student centred learning but have also raised concerns with the potential to severely threaten aspects of quality as viewed from the conventional academic framework [Ferguson, 1999].

Poor usability can arise from a number of factors: - bad design with over-complex graphics giving long download times, lack of search mechanisms on large sites, inconsistency in approach, broken and out of date links that fail to lead to the declared content, syntax or semantic errors in text, etc. New and improved Web authoring tools, encompassing templates, make it easier at the design stage to produce reasonably acceptable results avoiding many of the pitfalls. However, any Web site of reasonable complexity will still harbour defects.

One traditional approach used to evaluate a user interface, and increasingly common for the evaluation of web pages, is usability inspection [Nielsen 1994]. This technique comprises a set of methods that are all based on having evaluators inspect the user interface. Inspection methods include:

- Heuristic evaluation where each usability specialist assesses whether each dialogue element follows established usability rules.
- Feature inspection outlines groups of sequences used to perform tasks, checks for long sequence trails or difficult steps that would not be normal for users to try.
- Cognitive walkthrough where a detailed procedure is used to model a typical user's problem solving activity at each step, checking if they lead to the next correct action.
- Standards inspection to ensure that the interface meets a published standard.
- Consistency inspection to ensure that the interface is consistent with other products forming part of the same family.

Regardless of which techniques are applied only a partial set of defects existing at the site will in general be found. Hence the need exists to construct an estimate of the remaining defects. This estimate would allow us to produce a fundamental measure of the quality of the Web site and can subsequently be used as a managerial aid on decisions with regard to increasing the quality of the site.

2. Process for estimating remaining defects

The characteristic used in constructing the estimate is a partial estimate of the number of defects in the site. Hence, unfortunately, we cannot attempt to construct the full estimate without undertaking an initial defect detection stage. Although this initial stage is straightforward, it obviously requires manpower and hence incurs cost. In fact this initial process is the major cost of deploying this technique. The initial defect detection process is simply a matter of deploying a number, say between 3 and 5, of individuals to explore the web space noting defects as they proceed. This exploration process should last for approximately 2 hours, during which the participant notes any defects they find.

The suggested duration is derived from other similar activities [Fagan 1976], as no information is currently available for the WWW sites. If the site is extremely large, then the participants should be asked to search the space repeatedly, in two-hour blocks, until they believe that they have fully explored the space. No specific instructions, information or process are required to be followed. In fact it is desirable that the participants search through the web space in a natural and uncontrolled manner, as the diversity helps to ensure that that different participants will find different faults. Further, additional techniques to increase the diversity are also desirable, such as selecting participants with different backgrounds or different interests with regard to the information space. Not only does this diversity increase the number of unique defects found, but it also simplifies the subsequent analysis; as the diversity helps us argue that each set of defects are found by a process which is completely independent from the processes deployed by other participants.

This argument, in addition to the fact that by definition the defects are mutually exclusive and all inclusive, allows us the use of a multinomial likelihood function to construct an estimate from this initial data. The final step in the initialisation process is for an individual or the team of participants to work as a defect oracle and decide which proposed defects are in fact false defects, which are duplicates and which are unique. Armed with this information we are now ready to construct our estimate of the total number of defects at the Web site.

3. Constructing a generic estimator

The multinomial distribution is the generalisation of the binomial distribution, and is introduced to most people as a model of the probabilities of dice throwing. The likelihood function, or sometimes the log-likelihood function, links the data (derived by the above process) with the unknown parameters (total number of defects) through a model that makes implicit all the assumptions (behaviour of participants; complexity of defects) underlying a process. Likelihood functions are the basis for rigorous inference in statistics.

Let N be the unknown number of defects; and k be the number of participants. Hence we can construct a binary matrix x' (N x k), which indicates if the j^{th} participant found the i^{th} defect[1]. Further we can associate a probability of this event occurring p_{ij}. Note that we are unable to observe this entire matrix as N is unknown. If we further define n to be the unique defects found during the initial process, then we can define a further matrix x (n x k) which is observable and is clearly a subset of x'.

Given these definitions we can define the likelihood function as[2]:

$$L(N,p \mid x) = \frac{N!}{\prod_{k} f(n,x_i)!} \prod_{N} \prod_{k} p_{i,j}^{x_{i,j}} (1-p_{i,j})^{1-x_{i,j}}$$

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[1] This relationship is assumed in the rest of the paper and will not be repeated for the sake of brevity.

[2] Note that the indexing has been removed from product symbols to aid readability. Formally: $j = 1, \ldots, k$, $i = 1, \ldots, N$.

where $f(n, x_i)$ is the number of defects found by participant i and no other participant. Likelihood theory now implies that the correct estimate of N is found by finding p such that this function is maximised, i.e. the maximum likelihood estimate has been found.

4. Constructing estimators based upon differing P_{ij}

The probability function as defined above can vary according to two sources of variance: the ability of the participants and the difficulty of finding defects. The joint probability model of these two effects represents the most complex formulation of this model. In this section we will discuss other simpler formulations (by limiting the number of variance parameters), which can also be used as estimators.

The simplest model is when the ability of all the participants is consider equivalent and the complexity of finding any defect is considered equal, i.e. $p_{i,j} = p$. Hence the above equation greatly simplifies and although the maximum likelihood estimator is straightforward (see [Darroch 1958] for a derivation), it is still not possible to describe it in a closed from and hence an analytical solution is not possible. This does not pose any great problems, as log-likelihood functions[3], by definition, are monotonic, and N is an integer value, hence nearly any simple iterative method will quickly find a solution.

Unfortunately this formulation is likely to be conservative, and, in general, will underestimate in the presence of variation in the two sources. If variation between the defects is the dominant feature then adding variation in this direction provides a more accurate model. For this model, $p_{i,j} = p_j$ is substituted into the equation yielding (after some re-arrangement):

$$L(N, p \mid x) = \frac{N!}{\prod_k f(n, x_i)!} \prod_k p_j^{n_j} (1 - p_j)^{N - n_j}$$

Unfortunately the authors are unaware of any public defect data for web sites, and hence direct evaluation of this model is currently impractical. Evidence exists in other fields [Chao 1987, 1988; Miller 1999] that the other source of variation (participant performance) is more important, but it is impossible to judge if that evidence transfers into this context. Again, as with the above model, the numerical solution to this formulation is straightforward. One possible addition to the model is to parameterise the probabilities with a confidence parameter indicating the certainty of assigning probabilities to individual defect 'types'. In the limiting case, no confidence, the model collapses to become the simpler model. The parameter allows the investigator to conduct a sensitivity analysis upon the assigned probabilities.

To model the performance of the participants we simply set $p_{i,j} = p_i$. Again substituting and re-arranging yields:

$$L(N, p \mid x) = \frac{N!}{\prod_k f(n, x_i)!} \prod_N \binom{k}{g_i} p_i^{g_i} (1 - p_i)^{k - g_i}$$

Where $g_i = g(k, x_i)$ and denotes the number of participants to find the i^{th} defect.

As noted above, evidence exists in other fields [Chao 1987, 1988; Miller 1999] that this source of variation (participant performance) is dominant (in these other fields), but again it is presently impossible to judge if that evidence transfers into this context. This formulation is more difficult to evaluate, due to the lack of knowledge of the size of the vector of probabilities (N). This difficulty can be outcome by the application of resampling methods, for example Burnham and Overton [Burnham, 1978] show how models of this type can be evaluated by constructing a Jackknife estimator, other resampling techniques, such as bootstrapping [Efron 1993], can equally be applied to this type of estimator. As above the probabilities here can be parameterised to allow sensitivity analysis.

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[3] Log likelihood functions are simply the log of the likelihood function and are extensively used to simplify problems, while retaining the characteristics of the initial formulation.

The final estimator is where variation in both dimensions is allowed (the generic case). Here the evidence form other fields is that, although theoretically this model should provide the best performance, trials suggest that to does not significantly outperform the participant's performance variation only model, due to its dominance over the defect variation in these other fields. Additionally this model has been found to be highly unstable for limited numbers of participants, and hence may be difficult to apply to this problem [Chao 1987, 1988; Miller 1999]. Again judging the value of this evidence within the context of this problem is difficult, but the unstable nature of this estimator suggests at least caution. An example of the use of models in this type, for 'large' numbers of subjects can be found in Chao [Chao 1992].

This leaves us in a situation of having multiple models, which are likely to produce differing estimates of N, and limited evidence for the selection of the correct model and hence final estimate. In fact the position is even worse than this, as three of the models require prior hyper-parameters (probability functions or parameterised probability functions) for estimation. Hence each potential combination of hyper-parameters represents a different model for the selection mechanism to consider.

The following section will outline one potential method of model selection [Carlin 1996]; unfortunately it is impossible to provide specifics without data from the problem at hand.

5. Model Selection

Selecting from competing models is a difficult, but essential undertaking. Many fields, using statistical models, ignore the model uncertainty. Data analysts typically select a model from some class of models and then proceed as if the selected model had generated the data. This approach ignores the uncertainty in the model selection process, leading to inappropriate inferences and over-confident in the derived estimates. Bayesian model selection and averaging provide a coherent mechanism for addressing model uncertainty, and hence providing more reliable estimates.

The Bayesian solution to this problem is to compute the posterior probability for each model. For model selection, simply choose the model that maximises this conditional probability, if several models provide similar values then the probabilities can be used as weighting functions in an averaging process.

Suppose that two models exist, $M1$ and $M2$, then we simply compute $p(M1/x)$ and $p(M2/x)$. To estimate the significance of the difference between to two probabilities, then we simply form the ratio of the two conditional probabilities. This quantity is known as a Bayes factor[4], and can be interpreted as the support for each model from the data. Unfortunately the interpretation of a Bayes factor is not exact, see Jeffreys [Jeffreys 1961 and Kass [Kass 1995] for slightly different interpretations, and hence the decision as to when one model is 'best' and when to average across several 'good' models is difficult. Again, the model selection mechanism requires empirical investigation within this context. When one model is a subset of the other, simpler likelihood ratio tests can be deployed, see Burnham [Burnham 1978] for an example of the use of likelihood tests with multinomial models.

Alternatively the model selection mechanism could attempt to use techniques for artificial intelligence, see [Kerans 1994; Chan 1996] for examples of techniques which could be adapted.

6. Conclusion

Given the explosion in the number of Web sites and the accompanying failure to increase their usability, the credibility of the Web to provide quality, easy to use sites is threatened. This problem is particularly acute within developing web-centric educational environments and products. If these are to succeed then the development of high quality products is essential.

Estimating the number of defects present at a Web site can lead to an important measure of its usability and will form a significant stage in its appraisal and overall progress to improvement of quality. This paper has presented a number of statistical models that could be used to obtain an overall measure of the number of defects at a site. It is believed that such measures and models of quality are essential for the Web to mature into a domain where appropriate quality standards can apply.

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[4] This is an approximate definition and assuming that the prior probability of equal model is equal, and hence can be omitted from the formulation.

To progress the work further, the authors would like to learn of suitable data collected from Web sites that would allow testing of the analysis and selection of the most suitable model.

References

Burnham, K.P. and W.S. Overton, W.S. (1978). Estimation of the size of a closed population when capture probabilities vary among animals. *Biometrika* 65:625-633.

Carlin, B. and Loius, T. (1996). *Bayes and Empirical Bayes Methods for Data Analysis*, Chapman and Hall, New York.

Chan, P.K. and Stolfo, S.J. (1996). On the accuracy of meta-learning for scalable data mining. *Journal of Intelligent Integration of Information.*

Chao, A. Lee, S. M. and Jeng, S.L. (1992) Estimation population size for capture-recapture data when capture probabilities vary by time and individual animal. Biometrics, 48:201-216.

Chao, A. (1987). Estimating the population size for capture-recapture data with unequal catchability. *Biometrics*, 43:783-791.

Chao, A. (1988) Estimating animal abundance with capture frequency data. *Journal of Wildlife Management*, 52(2):295-300.

Darroch, J.N. (1958) The multiple recapture census: I. Estimation of a closed population *Biometrika* 45:336-351.

Efron, B. and Tibshirani, R. (1993). *Introduction to the Bootstrap*, Chapman & Hall.

Fagan, M.E. (1986). Advances in software inspections. *IEEE Transactions on Software Engineering*, 12(7):744-751.

Ferguson, J.D., McGettrick, A.D. and Smeed, D. (1999). Quality Issues in a Virtual University, *proceedings of CATE'99.*

Kearns, M.J. Schapire, R.E. and Sellie, L. M. (1994). Toward efficient agnostic learning, *Machine Learning*, Vol. 17, pp. 115-142.

Miller, J. (1999). Estimating the number of defects in software artefacts, *Journal of Software Testing*, Verification and Reliability, forthcoming.

Neilsen, J. (1999). User Interface Directions for the Web, *Communications of the ACM*, Vol. 42, No.1.

Neilsen, J. and Mack, L. (1994). *Usability Inspection Methods*, John Wiley & Sons, New York.

Assessing the Success of Seminars on the Web

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Abstract: The purpose of paper is to examine user feedback and usage patterns of the Course Submission System, a web based environment for the facilitation of online multimedia seminar classes. Three courses were taught in succession using the same online seminar system. Each course increased enrollment and thus overall use of the system. Students in the first test semester participated in a completely web-based course. The second and third courses utilized the same software but were web-assisted: while the course met "in person" each week, some classroom interaction and all of the presentation of student work was mediated by the seminar courseware. This paper assesses the strengths and the deficiencies of a model for web-based collaborative courseware in the context of the seminar and the larger course and details improvements to the software based on assessment.

1. Introduction

The Course Submission System was initially designed to address the needs of students participating in multimedia production seminars. The system facilitated the submission of on-line projects via an easy to use graphical interface. The system also provided facilities for the instructor and the students of the course to view submitted multimedia projects. In addition, the system also provided facilities for students to critique other's work through an asynchronous comment area bound to the multimedia content [Flanagan 98].

The prototype Course Submission System, renamed as the courseware "Integrated Online Seminar System" (IOS), represented a technological solution to a common problem – successfully addressing students with diverse backgrounds through courseware design. It provided an easy to understand user interface, a simple upload model, and an outlet for dialog and critique that was fundamentally different from that of newsgroups in that conversation was centered around the media content posted on web pages. The IOS system has been utilized over a period of three semesters at the university level. Over this time, the system's user interface and other aspects have been studied through surveys and usability testing. We have also monitored server usage patterns in order to correlate them with user's comments to the system. Although the technological solution has provided a strong first step in the development of the application, social aspects in the usability of the system had to be highlighted in the next version of the courseware. In order for the application to be useful, it had to combine technological advances with sociological models to support co-dependent work [Grudin 91]. We will examine some of the more problematic areas in the use of the system, and how technological and sociological solutions were addressed to overcome these issues.

2. IOS System

In order to describe the assessment and subsequent adjustments of the IOS system, we must examine the architecture. The IOS system consists of two applications: an administrator component and a student component. The administrative component is a database application that allows a class instructor to create record entries for courses, students, and projects. The administrative application can monitor the progress of a student in a class by reporting on the current submission status of their project, level of participation within the comment area, and monitor the student's usage patterns within the system. The class instructor can use the administrative application to dynamically change items within the class, such as adding or deleting assignments, changing due dates, and locking student work as scaffolding examples for future classes. Finally, the administrative system is responsible for maintaining a file structure capable of storing student submissions and critique text.

The second half of the IOS system is the web-based student interface. The web approach was chosen since it offered the flexibility for cross-platform operation and for allowing students submit their work from both school and home. The IOS system utilizes Java Servlets [Davidson 98], which can be best categorized as server-side applets, for several system tasks. The servlets are responsible for accessing database information and for dynamically generating HTML content pages. The servlets are also responsible for facilitating the upload service. When a student participates in an IOS session, they are presented with a link-based navigational interface that allows for the selection of a course, student, and project. These navigation pages are dynamically generated by the servlets. When the student navigates to a project area, several frames are displayed which allow space for commands, multimedia content, and critiques. The student then has the option to either post a comment or to submit multimedia content. The system is protected through an authentication mechanism such that only class participants can post comments, and only the owner of a particular page can submit content. All student comments are tagged with the poster's name and the time of posting.

3. Assessment

Over the last year and a half, the IOS system has been utilized in three digital media university classes: a production course for the design of multimedia interfaces and two media theory courses. The production course required that students create interface designs as images, while the theory courses allowed students to explore a wider range of web-accessible media content. The courses also differed in that the production course was geared for a limited number of advanced students with working on multimedia design, whereas the theory courses contained more students and a wider range of diversity.

Each group of students who used the courseware were surveyed twice--once eight weeks into the semester and once at the end of the semester--in order to assess usability and acquire other kinds of feedback. Thus far, we have surveyed three class groups in three succeeding semesters. The first group, an upper level undergraduate and graduate seminar, involved 6 students. The second course was a media theory course with a mixed enrollment of 22 advanced undergraduates and graduates, and the third was a similarly structured course with a total of 26 students. Some of the benefits of the courseware cited by students were the efficiency of the system, the disuse of paper, the accessibility of the student work to other courses and friends of the participants, and increased possibilities for participation. One student noted that the interaction between "both shy and loud, outgoing people" was enhanced by the system. In addition, the administrator was also surveyed.

Although the IOS system proved to be an asset in providing these classes, user feedback noted some obstacles in interacting with the system. The data proved that we needed a revision of the original IOS on both the administrative side and the student side of the application. We grouped the obstacles into five categories: *administration, navigation, group management and participation, naming convention/posting, and representation.*

3.1 Administration

A central issue from an administrator's point of view was that the courseware had to be administered *on* the server. This is because the original database was tied to a specific application--Microsoft Access. The security model presented to users on the server prohibited remote administration of the database. The solution was to separate the application from its dependence on Microsoft Access and create a platform-independent web-based interface for administration.

3.2 Navigation

One of the primary student concerns was the navigational model. The system design required that a student navigate from course to student and then from student to project in order to view submitted content. The reason for the original design was to create a uniform navigational space and to create a strong relationship model between the class components. In classes conducted using web technology before the use of IOS, students often posted their media content to their own web page; this ad-hoc structure generated confusion and frustration when trying to find student work and resulted in inconsistent navigational models. Content location varied widely.

Although there is a great deal of importance in maintaining a uniform navigational model, it is also important to have different methods of access and filtering for content. In the original IOS, students spent a great deal of time utilizing the navigational interface instead of viewing and critiquing content. We designed two navigational structures to provide unique and variable access to content: a portfolio mode, which organizes the navigation into particular "student sets" (looking at work which belongs to a particular student), and a project mode, which organizes the navigation around a particular class. We are also experimenting with navigational control panel to allow quicker access to the next student and next project within a particular set.

3.3 Group management and participation

Group management and participation were also surveyed. When IOS was initially deployed, it was used in a relatively small class of advanced students. Students could easily monitor the progress of their classmates and could critique all of the work presented because of the scale of the course. As the IOS system was used in larger classes, it became more difficult for the students to keep track of who had submitted work. In addition, students tended to cluster their comments around particular individuals in the class, leaving other students out of the communication process. In order to address this particular problem, we had to look at two issues: social mechanisms to report the status of individual work, and mechanisms to enforce equity in the comment process. The first problem was the easier of the two to address. In order to provide stronger feedback mechanisms, we now are providing two-part indicators in the project mode to indicate the submission status of a project. The first indicator reflects submission changes on the system. A class participant can view the class list involved in a project and quickly assess who has submitted new work and when. The second indicator is a student self-assessment. The student is able to provide commentary and an indication of the state of his or her work. By incorporating both indicators, it is possible to quickly access the status of individuals for a particular project. The indicators are incorporated into the navigational model to allow quick access to work that has changed. The second problem was more difficult to address. Although it is desirable to have a degree of freedom when choosing which work to critique, the equity issue of distributing comments and increasing overall participation is equally important. Although it would be desirable that students comment on every piece of work, this is not often feasible in larger classes. In order to create a degree of balance, we added a comment requirement to the system. The comment requirement manager is housed in the administrative section of the system, allowing an instructor to set a requirement per project as to the number of comments expected of each student. When this requirement is set, the system generates a list of participants per student for which he or she will have to comment. Status of both submission changes and student self-assessment is represented graphically. Of course, students can comment as much as they wish once they have met their "comment quota". One question we encountered in the design of the commentary requirement section: "What if one student must review another student who has not yet submitted work?" In the event that a student does not submit work by the due date, those dependent on the delinquent student are reassigned to other individuals.

Comment management also presented difficulties to students. As part of the old IOS model, graphics or multimedia content was displayed in a frame separate from that of the critiques and comments. In this manner, multimedia content did not have to be reloaded for each comment viewer by an observer. However, as the comments increase in frequency, the viewer was responsible for noting where he or she left off in the viewing. We have designed a new view model that will allow a user to either see the entire comment list, or view only the most recent additions. We have also considered adding automatic archival systems in order to automatically sort comments and generate navigational links.

The upload servlet also had to be addressed. Initially, we used a generic upload servlet to perform media transfer. Unlike the download process within a web browser, the upload servlet did not indicate the current percentage of transfer nor the transfer data rate. Although many of our students used the on-campus facilities connected through an Ethernet network, home users were often unsure as to the status of their transfer. Systems such as BSCW (Basic Support for Collaborative Work) approach the problem by creating separate helper applications for the upload process [Bentley 97]. To simplify the transfer process, we extended of the servlet model to create a low-priority feedback mechanism within the server that can be used to relay upload status information to the browser. We also plan on extending the upload model to support multiple file and directory submission procedures so students will not have to submit content as individual files.

3.4 Naming Convention/Posting

Because of the naming conventions established by commercially available server software, we were restricted to using specific filenames. According to our survey results, submission was not easy at first, and the naming convention was most frequently cited as the problem. The larger the course size, the more common this problem became. Students became confused as to the types of specific files allowed on the system and had difficulty remembering that "index.htm" was the specific name that had to be included in the post, not "index.html" or "studentproject.htm." In addition, the interface did not easily indicate the way in which multiple items (such as a web page and graphics) could be posted successfully. In fact, the html page had to be submitted prior to the images on the page. Students also had difficulties with authentication. The IOS system requires a user name and password when the student wishes to submit media content or to participate and critique work. Authentication used to be requested each time one of these operations were performed. To address the authentication and re-authentication issue, we had considered using cookies to maintain password information, however many of our students use public access labs and often forget to close their browser sessions. We considered different active timing techniques to monitor activity and to close the session when a student is idle for a fixed amount of time. This issue remains open. To help students with naming and posting, we decided to use automatic page generation and framing techniques to mask the specific process of naming, thereby allowing students to submit with a variety of inconsistent file names.

3.5 Representation

In response to respondent requests, we developed a servlet handler for image data, capable of generating thumbnail images to assist in the navigational process. While this aspect also pertains to navigation, it makes the system more colorful and "lively", as imagery is immediately accessible for review purposes in small, easily downloaded file sizes. Another representational element incorporated into the system was a whiteboard image review and processing area. As the saying goes, "a picture is worth a thousand words", and it is often advantageous to suggest a media alteration through graphic changes to the content. It is equally as important to markup images to prevent ambiguities about the critique. At first, we examined mechanisms used in anchored collaboration schemes [Guzdial 97]. However, after examination, we decided the system needed something more than text anchoring, as students wanted the ability to perform simple editing to each other's images. In order to accommodate the request, we are in the process of developing an asynchronous whiteboard applet to be used in conjunction with the IOS system. The system will extend the anchored text model by allowing anchored media changes. Alterations will take place in the form of layers. We chose to implement a layers approach to maintain the integrity of the original submission and to minimize transfer time. As a student views a comment, the layer will be superimposed on the original work. Follow-up comments can either utilize the original media image or a combination of previous layers when formulating a response. The actual whiteboard application will provide simple editing tools such as lines, fills, and color maps, along with pre-defined objects such as arrows and shapes to facilitate the markup process.

4. Conclusion

When assessing the success of IOS, we examined to examine user feedback and usage patterns with the application. We found that we needed to rethink the initial implementation of the courseware. Our student surveys indicated that although our initial implementation addressed certain key technological issues, there were several social issues that needed to be considered. We explored techniques to integrate new mechanisms into the IOS system as a whole. We also leveraged the technology to integrate sociological solutions in the design of the application. The improvements to the IOS system address each of the documented student concerns. We plan to continue testing to see if these ways of redesigning the courseware prove effective. Through assessment, we are also looking at new paths to follow when expanding the use and capacity of the application.

5. References

[Bentley 97] Bentley, R., Appelt, W., Busbach. U., Hinrichs, E., Kerr, D., Sikkel, S., Trevor, J. & Woetzel, G. (1997). Basic Support for Cooperative Work on the World Wide Web. *International Journal of Human-Computer Studies*, 46(6), 827-846.

[Davidson 98] Davidson, J. & Anmed, S. (1998). *Java Servlet API Specification*. Palo Alto, CA: Sun Microsystems.

[Flanagan 98] Flanagan, M. & Egert, C. (1998). The Course Submission System: Providing "Seminars" on the Web. *Webnet, 1998*, Association for the Advancement of Computing in Education, Orlando, FL. 313-317.

[Grudin 91] Grudin, J. (1991). CSCW: The Convergence of Two Development Contexts. *Conference on Human Factors in Computing Systems, 1991*. Association for Computer Machinery, New Orleans, LA. 91-97.

[Guzdial 97] Guzdial, M., Hmelo, C., Hubscher, R., Nagel, K., Newstetter, W., Puntembakar, S., Shabo, A, Turns, J. & Koloder, J. (1997). Integrating and Guiding Collaboration: Lessons Learned in Computer Supported Collaborative Learning Research at Georgia Tech. *Computer Support for Collaborative Learning, 1997*. Toronto, Ontario, Canada. Online. http://www.oise.utornoto.ca/cscl.

The Critical Position of the Internet in the Creation, Development, and Maintenance of the Bronx-Wide (New York) Superintendents= Instructional Technology Leadership Forum

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Abstract: In 1998, the Bronx-Wide Superintendents' Technology and Learning Leadership Forum was created to investigate effective ways to support students' learning and achievement with instructional technology. The formation of the Forum is critical at this time because of the pressing urgency to build a firm educational foundation needed to support Bronx students development as creative and critical thinkers who must live and compete in the global communities that will characterize their 21st century world. Our effective use of the facilities of the Internet brings the possibility to significantly alter how Bronx students are being educated to prepare them for the 21st century by allowing for the articulation of curricula across PreK-16, by allowing for productive communication between and among shareholder representing multiple perspectives, and by allowing for Bronx-wide long-range instructional technology planning to take place.

Introduction

In this presentation, I will provide a to-date summary and review of the activities and progress of the development of an urban long-range instructional technology planning initiative in the Bronx, New York. A major goal of this initiative is support systemic educational reform with the development of Leadership Teams composed of superintendents, principals, teachers, students, parents, and community members. The ongoing and critical link between all participating members will be maintained through the facilities of the Internet.

Long range instructional technology planning, implementation, and evaluation are complex and involved processes that require the proactive participation shareholders within a school, across a school district, and, in this project, across the borough of the Bronx. A basic belief of this Bronx-Wide project is that educators, families, and not-for-profit and commercial community members hold a shared responsibility to ensure that instructional technology is infused effectively to support students learning and achievement. The Bronx pre-kindergarten child entering school in 1999 must be fully prepared upon graduation in 2013 to be a participating member of the global communities that will characterize her world.

The vision of the 21st century that we are determined to create into a reality is composed of students who are problem posers, problem solvers (Dede, 1998), effective users of telecommunications and information technologies (Ramirez & Bell, 1998), and literate information users (Breivik, 1998) in the evolving global communities that will characterize the 21st century. Jones et al (1995) has made it clear that our students must be prepared for a world different than the one their parents graduated into:

> Today=s workplaces and communities B and tomorrow=s B have tougher requirements than every before. They need citizens who can think critically and strategically to solve problems. These individuals must learn in a rapidly changing environment, and build knowledge taken from numerous sources and different perspectives. They must understand systems in diverse contexts, and collaborate locally and around the globe (p. 5).

The New York City Board of Education and the Bronx

In order to understand the potential role the Internet can play in the future of education in the Bronx, it is necessary first to build an understanding of the history and structure of the New York City public school system and governing Board of Education. The New York City Board of Education is the largest school system in the country, with a student population of nearly 1.1 million, a budget in excess of $8 billion, and more than 1,533 facilities. Its policy-making body is the seven-member Board of Education, comprised of two mayoral appointees and one appointee selected by each of the five borough presidents (Bronx, Brooklyn, Manhattan, Queens and Staten Island). Responsibility for the day-to-day administration of the schools is vested in the Chancellor, who is selected by the Board. Throughout the five boroughs, there are 32 semi-autonomous PreK-8 community school districts, each serving each serving 12,000 to 40,000 students. The high schools of each of the five boroughs is governed by a Borough-level high school superintendent and staff (NYC BOE, 1999).

Following the appointment of Chancellor Crew in 1995, the structure of the NYC BOE has begun to be systematically changed in order to address problems arising from ineffectual administration both at the individual school district levels. In December 1996, the New York State Legislature passed a landmark school governance reform bill that established clear lines of authority and responsibility necessary to ensure a system fully accountable for the educational achievement of all children. The governance law gives the Chancellor direct responsibility for the selection and renewal of the 32 community school district superintendents, and the authority to intervene in any district or school for persistent educational failure. The law also provides for greater parental involvement and the opportunity to strengthen the focus of community school district boards on educational policy matters and promotion of student achievement (NYC BOE, 1999).

Unfortunately, one of the consequences of the structure created by 32 community school districts and the separate high school divisions has been the lack of articulated and coordinated curricula from PreK through high school. When decentralization began, no formal structure was put into place to provide for either a deliberate or planned articulation of curricula within Prek-8 districts, between Prek-8 districts, or between the 32 community school districts and the high school division. There are no structurally effective or efficient means to support students' academic movement from their Prek-8 school environments into the high schools.

An additional significant challenge has arisen in the past two years with by the New York State Department of Education's mandating that all graduating 2002 high school students must pass the new NY State Regents. A range of predictions have been made regarding the number of students prepared to pass these far more rigorous tests, ranging from fewer than 10% to 50%. Students are placed in an alarmingly precarious position in an educational system in which curricula is not being articulated across the grades and in which the professional development of teachers is not being conducted between the PreK-8 community school districts and high school division.

In the borough of the Bronx there are many significant educational challenges to be addresses. There are currently 228 schools serving approximately 223,437 students PreK through high school. Approximately two-thirds of Bronx students are identified as low-income. Approximately one-third of the students are English language limited, and one-third are first-generation immigrants.

Building a Bronx-Wide Superintendents' Technology and Learning Leadership Forum

The decision to build a Bronx-wide initiative began April 1997. At that time an advisory group of Bronx school district technology coordinators requested that the College take the lead and initiate a program to assist schools in the Bronx begin the complex task of long range instructional technology planning. All the school districts face numerous problems and challenges in determining how to allocate resources to a majority of students who live at or near the poverty level and do not have home access to up-to-date technology. However, there were several complications that prevented my becoming the initiator of such a daunting challenge. Since I was the newly appointed and only Educational Computing and Technology faculty member, I felt I needed to learn my way with the districts and my own Division before beginning. Also, at the time, our Dean of the Division was not yet appointed, and we needed to locate additional sources of support and collaboration.

By the Fall of 1998, the picture had changed and the earlier problems had been partially solved. The Dean of Education was appointed and had accepted the challenge to move the Division into a 21st century vision of education supported by instructional technology. I had had many discussions with the school districts and had managed a number of successful instructional technology projects in the College and in the district schools, thus proving my credibility. The BUSI (Bronx Urban Systemic Initiative) had agreed that long range instructional technology planning was necessary so that schools would have a clear plan to follow to support student learning, particularly in the areas of mathematics and science. Also, the development of effective instructional technology plans had recently been identified as a major goal of the BEA (Bronx Educational Alliance, one of the National Centers for Urban Partnerships sponsored by the Ford Foundation). NetTech (the Northeast Regional Technology in Education Consortium, funded by the US Dept. of Education, Office of Educational Research and Improvement) had agreed to support a Bronx-wide major collaborative initiative and to bring to the table their many regional resources. Also, the faculty had decided to move toward NCATE (National Council for Accreditation of Teacher Education) certification for our education programs. The time had arrived to move forward.

Why are we emphasizing the critical role of the Superintendents in the development of this Bronx-wide initiative? In the *Buckeye Association of School Administrators: Technology Ad Hoc Committee Report* (1998) the significant and necessary role of the superintendent as a technology leader has been duly noted by superintendents:

> The Superintendent is a key player in a school district developing a high-quality, technologically literate learning environment. As the district's leader, the Superintendent sets the expectation for technology being an integral part of the instructional program as well as daily district, school, office and classroom operations. The Superintendent serves as a catalyst, sharing a vision and plan which supports educational goals that incorporate emerging technologies and allocates adequate financial and staff resources.

Leadership Forums - April 28 and May 8, 1999

On April 28 and May 8, the first two Bronx Superintendents' Technology and Leadership Forums were held to bring the Leadership Teams together to begin planning a Bronx-wide initiative. Five of the six Bronx PreK-8 community school Superintendents, the Superintendent for Bronx high schools, and the Superintendent for alternative high schools brought their designated leadership teams to meet for two-full days of collaboration to develop a more informed understanding of long-range instructional technology planning. Also participating in the Forums was Lehman College (CUNY), the United Federation of Teachers (UFT) Professional Development and Teacher Centers, Bronx Community College (CUNY), Hostos Community College (CUNY), the Bronx Educational Alliance (BEA), the Lehman Center for School/College Collaboratives, the Bronx Information Network (BIN). Guest speakers were from the Bronx school districts, New York State, and the region, including participating organizations collaborating with NetTech, presented components of a 21st century school. Their presentations addressed a number of important issues, including: alignment of the National Education Standards for Students (NETS) and curricula, Bronx-wide instructional technology assessment, funding, home-to-school electronic linkages, corporate partnerships, professional development of teachers and administrators, student achievement, information literacy, and infrastructure planning.

Feedback from the Leadership Teams on the two Forum days indicated that the time is at-hand to move a Bronx-wide initiative ahead. The opportunity for participants to network and share information across districts/schools was cited by well over half of the respondents as the best thing about the day overall. "*This forum will provide us with opportunities to formalize our discourse re providing the best education that we can for the students that we serve.*" Other comments from participants about the best thing about the day included:

$ "...a united commitment to work on technology."
$ "...seeing the way technology is being integrated in the curriculum."
$ "Learning about collecting data across the state."
$ "A smart, focused effort about technology and our students is long overdue."

A majority of the participants agreed the Forums helped them to identify Bronx-wide PreK-16 topics for future development. Some of the concerns raised by the participants concerning PreK-16 were: how to reach out to the entire educational community; expanding technology in classrooms at reasonable cost; identifying resources and alternative funding arrangements; developing a vision of the classroom five years from now; disseminating professional development websites borough-wide; providing effective professional development activities; bridging the gap to full integration of technology in the classroom; training future teachers for teaching with technology; and how borough-wide planning will benefit the schools and districts.

Participants were prepared to take steps concerning PreK-16 such as continuing to be involved with the Forum (planning sessions) and getting others involved, debriefing the district and drawing up action plans for replicating strategies, sharing district best practices with a larger audience of teachers and parents, and adding a parent page that includes distance learning for parent involvement.

Several barriers to moving ahead on PreK-16 were identified. They included the need to involve more people, time for staff development, ongoing costs associated with the installation, maintenance and upgrading of equipment, political issues, fear of technology that hinders implementing technology in the classroom, teacher lack of competence in the use of technology, and student lack of access to technology.

Despite these roadblocks, participants had suggestions about what the group should do next to further the uses of technology in the Bronx:

- Involve more teachers and college faculty in the Forums;

- Create an Intranet;
- Continue to hold Forums and update the web pages;
- Develop guides to instructional models;
- Connect with current programs;
- Explore existing software and hardware applications;
- Identify exemplary classrooms where technology is integrated into instruction and videotape them for inclusion in a video library so others can view them;
- Model technology projects already accomplished in Bronx districts; and,
- Organize a borough-wide "share fair" to have each school display exemplary work.

During the Fall 1999 and Spring 2000, Bronx-wide action teams will be formed and will begin the work of developing, implementing and assessing proactive plans to address these several identified areas. The teams will be composed of shareholders representing multiple perspectives and interests with the goal for all to support students' achievement and success.

The Multiple Roles Intended for the Internet

The Internet has been selected as the organizing structure to ensure the success of the development and articulation of the pro-active goals of the Bronx-Wide Superintendents= Technology and Leadership Forum. Realizing that one of the keys to the successful implementation of this Bronx-Wide initiative will be communication between partners, electronic connectivity is one Internet tool that we are making use of and intend to make as accessible and equitable as possible. The extensive planning to design the forums is supported by electronic discussions and on-line video-conferencing. Many important WWW resources have been identified to support the superintendents and principals' work. Through the use email and listservs the superintendents' teams can share ideas and proposals, debate issues, present data and information, and pose questions for ongoing consideration. The many shareholders (educators, parents, students, community organizations, government agencies, and commercial investors) who are involved will be kept informed and involved. Action teams that are developed to address specific topics, issues, and questions (several identified above) will be able to identify and share resources, formulate plans, and assess their progress (http://www.lehman.cuny.education/bronxsuperpage).

In addition to the areas listed above, actions teams will be supported with Internet-based facilities and resources to address additional areas:

- the creation of a *Bronx-Wide Virtual Teaching, Learning, and Research Center* to support life-long learning of students, families and educators;
- the dissemination of guidelines and the provision of on-site support to assist superintendent-lead and principal-lead leadership teams to develop, implement, and assess long range instructional technology plans;
- the formation of pro-active plans and proposals addressing Bronx-wide instructional technology issues and problems;
- the coordination of instructional technology services across the Bronx;
- the development of a plan to address the significant problem of equity and access for Bronx students;
- the participation of the Bronx Superintendents= Technology Leadership Teams in regional and national technology and computing organizations and forums;
- the articulation of PreK-16 (pre-kindergarten through college) student learning goals to be supported by identified forms of instructional technology in alignment with NETS;
- the development of long-range instructional technology plans that include seven identified components (student learning goals, assessment, professional development, infrastructure, hardware and software selection, staffing, and funding);
- the location and effective use of resources for grant development;
- the development of specialized collaboratives and partnerships between districts;
- the identification of additional resources to support the implementation of long range instructional technology plans; and,
- the development of additional collaborative and partnerships with the Division of Education and Lehman College to support the ongoing preparation of preservice education students and inservice teachers to effectively integrate instructional technology into the curriculum to support student learning.

References

Breivik, P.S. (1998). *Student learning in the information age*. Phoenix: Oryx Press.

Bronx Superintendents' Technology and Learning Leadership Forum (1999). [Online]. Available: http://www.lehman.cuny.edu/education/bronxsuperpage

Buckeye association of school administrators. (1998). New York: NetTech.

Dede, C. (1998). *Learning with technology: 1998 ASCD yearbook*. Alexandria, VA: ASCD.

Jones, F.B., Valdez, G., Nowakowski, J. & Rasmussen, C. (1995). *Plugging in: Choosing and using educational technology*. Oak Brook, Ill: NCREL.

National educational technology standards for students (NETS). (1998). Eugene, Oregon: ISTE.

New York City Board of Education. (1999). [Online]. Available: http://205.232.145.43/

The Office of Education Affairs, New York City. (1969). *A summary of the 1969 school decentralization law for New York City*. New York: Author.

Creating Hybrid Instruction: A Lens for Defining Exemplary Teaching in Distance Learning

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Abstract: The Military Career Transition Program (MCTP) at Old Dominion University is the primary alternative certification program for teacher licensure targeting military personnel who are transitioning into education careers. Beginning Fall 1998, the MCTP added distance learning to its existing course offerings at five of its fifteen sites. These courses follow a hybrid instructional model, which include VTEL and web assisted instruction. Broadcast instructors and instructional facilitators at each distance learning site are utilized to facilitate collaborative, problem-based learning. This paper describes the evolution of the MCTP distance learning effort and examines the progression of strategic decision making involving the issues of course integrity, exemplary instructional methodology, and student accountability.

Introduction

In designing distance learning instruction the "garbage in, garbage out" tenet holds true as it does in any other kind of instruction. Quality distance learning depends upon: 1) sound curricular design, 2) exemplary instruction and 3) proper support, whether defined as technology resources or finances. These three variables do not carry equal weight in distance education; no amount of money or technology compensates for a lack of instructional skill or attention to curricular design. We maintain, based upon our experiences, that a hybrid instructional model which combines synchronous, asynchronous, and web based instruction supported by a team approach to goal setting and curricular design maximizes exemplary distance instruction, and therefore distance learning. This paper describes the curricular design process involved in broadcasting the core courses of the Military Career Transition Program (MCTP) at Old Dominion University. The development process detailed herein chronicles an ongoing effort that began in October 1998 involving three phases: creation of the instructional model and course technical support, instruction and broadcast delivery, and course and production refinement. The first six core pedogogical courses have been broadcast during Spring and Summer of 1999. Six additional courses, four instructional methodology courses and two educational electives, are slated for broadcast in Fall 1999 and Spring 2000, completing the MCTP degree program.

Background

Since its inception in 1988, Old Dominion University's MCTP has been extraordinarily successful in preparing and placing its graduate teacher candidates. More than 1200 graduates are teaching in 47 states, over 1400 students are currently in the program, and about 150 new teachers are graduating and being certified each year. The MCTP now offers one baccalaureate program, three master's programs, and a collaborative Certificate of

Advanced Study with the Educational Leadership and Counseling and Educational Curriculum and Instructional departments. Teacher licensure is offered at all grade levels, with additional endorsements available in Special Education and Technology Education. The MCTP offers standard semester courses as well as a compressed curriculum designed to meet the needs of deploying active duty military personnel.

In 1998 it became apparent that the MTCP alternative certification program possessed great marketability, both within the existing MCTP sites and through the established Old Dominion University distance education delivery system (TELETECHNET). No alternative paths to teaching licensure existed through distance learning prior to MCTP broadcast courses; traditional licensure methods almost always excluded active duty military personnel due to residency requirements. The MCTP distance education program broadcasted its first courses in January 1999 to a waiting constituency of students at five sites in Virginia, the District of Columbia, and the state of Washington.

Developing the Hybrid Model of Instruction

The current model for distance learning generally involves simply broadcasting existing live courses with little or no thought to reinventing instruction or selecting faculty best suited to broadcast. The major difficulty with this model is that it effectively ignores every available piece of reliable research on effective teaching (Hunter 1982, Joyce & Weil 1986, Fisher & Berliner 1985) which speaks to the delicate balance between sound planning and execution of instructional strategy. To say that it suffices to take mundane pedagogy that few people see and broadcast it for the multitudes negates our commitment to distance learning students; in effect we are saying that students pay for convenience with acceptance of mediocrity. Even with the more masterfully taught courses, there tends to be a lack of reinvention of instruction or curricular redesign— existing syllabi, course requirements, and instructor notes are simply posted to a course web site. Delivery of instruction is generally relegated to the "talking head" or "talking head in a box" superimposed over transparencies or electronic presentations. Current distance learning faculty tend to see themselves as presenters of material rather than facilitators of learning.

Confronted with these issues, we began the design of the Exemplary Teaching for Distance Learning (ETDL) Model. During the previous year, the MCTP elected to commence a comprehensive examination of existing curricula and redesign course competencies and requirements independent of any distance learning concerns. In order to accomplish this, teams of faculty members gathered in curricular groups to assess course outcomes, discuss strategies, and essentially "slash and burn" the curriculum with an eye toward what truly makes our students successful in the educational workforce. The resulting curriculum is a competency based course guide that ensures quality of instruction and consistency among the fifteen sites at which the MCTP is offered. Once the concept of offering the MCTP through distance learning was fully explored, a commitment was made to proceed with the new delivery methodology using the revised curriculum. A selected "team of experts" began program goal setting and logistic decision-making. It is this step which concretely began the MCTP distance learning effort and the construction of the ETDL Model.

An examination of the MCTP distance learning team is essential to understanding the importance of curricular redesign as a contributing factor to quality distance learning. The team consisted of College of Education instructional technology faculty, a curriculum design specialist, staff from the University Center for Learning Technologies and Academic Television Services, and potential broadcast faculty who were teaching MCTP courses. The advantages this approach gave included the ability of each team member to bring to the effort their own unique area of expertise, ensuring that exemplary input would yield an exemplary product. This team made decisions that included broadcast dates, times, locations, and program sequence. It became apparent that the curricular revisions of the previous year would not adequately ensure quality distance teaching. What followed was a process that can only be described as curricular reinvention. Courses taught over the normal 14 week semester had to be condensed into blended synchronous/asynchronous/web-based instruction with 50% less direct contact between broadcast instructor and student. In addition, course competencies had to be translated into web-based activities that would ensure student learning and provide critical assessment information for the instructors. Each instructor submitted a conceptual framework of requirements that they felt would lead to mastery of course competencies. The curriculum design specialist converted the original course competencies into problem-based learning and collaborative action projects that would increase student accountability. The instructional technologist then made logistical decisions regarding which activities were conducive to web based instruction. Based on those decisions, the course web site was developed. The breadth of experience represented on the design team played an important role in the development of blended courses that retain the integrity of the original course goals.

Course Reinvention

The MCTP reinvented rather than redesigned its core courses to better meet the needs of distance education students. Most distance education courses were previously taught with a traditional, teacher-directed approach. Students expressed dissatisfaction with this method of instructional delivery and disillusionment with their inability to customize course content and requirements according to their needs. Based upon these observations, the MCTP team decided that distance education courses should place the responsibility of problem solving and discovery upon the individual who desires the learning, thus allowing for greater customization of coursework. This concept alone created the need and the basis for the complete reinvention of curriculum, and more importantly the retraining of faculty who would need to take the leap of faith necessary in transferring accountability to students. Courses were designed with opportunities for students to customize content issues through threaded discussions on the web site and collaborative projects. Rather than creating increased student accountability by assigning more work, faculty were encouraged to adopt a problem based learning approach which would create motivation among students to acquire competencies. For example, in the core lesson planning course, MCTP students were required to work with classroom teachers in a school of their choice to design and teach problem-based learning units for pupils in grades K - 12. In the educational foundation course, teams of MCTP students attended and presented potential solutions to current problems with block scheduling, alternative schools, and national standards at school board and school faculty meetings. MCTP special education students developed an Individualized Education Plan (IEP) and case studies for the purpose of providing classroom remediation and intervention strategies.

Design Chronology

Three basic areas of learning were identified: broadcast instruction, web assisted instruction, and individual student-centered research. The initial decisions made by instructional faculty concerned the placement of course competencies in one of these three categories for course design. Concepts which needed to be communicated via "talking head" or which contained large amounts of overt information were relegated to the broadcast instruction category. This allowed faculty to retain control over the amount of content, depth of content, and the pacing of instruction during each broadcast session. Retaining a small portion of lecture format helped alleviate faculty fears that they would not be able to cover an appropriate amount of material in the reduced teacher-student contact time. Web assisted instruction consisted of a course website designed to clarify requirements, chronologically organize content and assignments, stimulate threaded discussions on controversial course topics, and provide space for on-line collaborative work across sites. Web assisted instruction was reserved primarily for application of course concepts taught via "talking head" and demonstration of contextual transfer of knowledge beyond the examples provided by the instructor. Student-centered research opportunities (collaborative projects, field research, and article analysis) were designed with the goal of creating motivation to delve deeper into content, customize the learning to meet individual need, and bring reality into the classroom discussions.

The bulk of course design then centered on the categorization of course concepts into three categories: those that would be introduced, those that would be taught, and those for which mastery would be expected. This filtering process was necessitated by the reduction of teacher-student contact time, previously mentioned. Modeling the tenets of effective teaching, faculty made critical but difficult decisions regarding depth and sometimes omission of content. In order to facilitate this process, a matrix was developed for each course, in which competencies were listed and catalogued by all MCTP faculty who taught core courses in any venue. Faculty were required to re-evaluate the critical attributes of their courses and determine what was relevant and what was related but less critical information. We were unprepared for how excruciating this consensus process would become. The tendency of instructional faculty to become proprietary regarding course content nearly overshadowed the concrete production parameters, i.e. time slots, equipment compatibility, taping capability, and presentation of visual aids. Ultimately, course visitations were made by a curricular committee to observe for each course, across sites, how the presentation of concepts differed. Consistency was critical because all MCTP students would be administered general comprehensive examinations at the end of their program. Where consensus seemed impossible regarding emphasis, final decisions were made by broadcast faculty in conjunction with the curricular specialist, and the official course syllabi were altered accordingly. These decisions were necessary, but rarely popular.

After concept categorization, faculty decisions were made regarding student accountability for each of the competencies. Prior distance learning experiences indicated that geographic distance contributed to a difficulty in assigning student accountability. The anonymity distance education students have tends to make them more passive and therefore less likely to invest in initiating and developing course goals and objectives. Additionally, distance education faculty indicated a reticence among students to be fully accountable for their learning. Generally, their solution to this has been to utilize traditional forms of summative evaluation more frequently than in their traditional classrooms. Prior research among TELETECHNET courses indicated that anonymity potentially reduces motivation among students in initiating and completing course tasks. Because the MCTP broadcast classes were two-way video as well as audio, students felt more connected and less anonymous but this issue remained a concern. Solutions to this problem were generated through alternative assessment.

Alternative Assessment

Alternative forms of assessment were perhaps the most difficult manifestation of student accountability. Both faculty and students seemed instinctively drawn to traditional course requirements (i.e. papers, tests, presentations), despite the fact that these methods of assessment did not accurately test mastery of the higher cognitive level course objectives. The move toward more alternative forms of assessing student learning (i.e. teaching vignettes, threaded discussions, inter- and intra-site collaborative projects, problem-based learning activities) provided better assessment information and offered students the opportunity to customize learning. In the specific examples noted above, students teaching problem-based learning units videotaped classroom instruction. These tapes, along with additional demonstration lessons in class, were analyzed and critiqued by peer coaching teams. The course competencies regarding effective teaching research (Bloom et al. 1981) were used as guidelines for assessment. The efficacy of solutions developed by the Educational Foundations class was critiqued by area school personnel as well as instructors and classmates with regard to realistic use of resources and the potential for positive impact on the school. More traditional forms of assessment were applied toward basic knowledge/comprehension level concepts taught during broadcasting. The special education class combined both traditional and alternative forms of assessment by requiring written Individualized Education Plans (IEPs), and detailed analysis of vignettes, as well as the nontraditional, more thought provoking threaded discussions posted to the course web site, encouraging student development of philosophy regarding controversial special education issues.

In all cases, the intent of curricular assessment redesign was to promote not only critical but creative thinking of students related to course competencies. Ultimately faculty decided that outcome based assessment required mastery of both course competencies and a higher level of metacognition with the material presented. The critical question in course planning became "What do I want my students to do ten years from now?" This lens assisted instructors in defining both critical attributes of the course and survival skills embedded within the content. It should be noted that all broadcast courses both required and valued student self-evaluations; commitment to formative as well as summative assessment was an important paradigm shift.

Conclusions

The resulting course quality has been equal to or better than the original traditionally taught courses, as evidenced by student demonstration of course competencies, student evaluation of instruction, and subsequent student performance in advanced courses. Any negative feedback from students concerning the distance learning courses has centered on access to the technology and the resulting steep learning curve required to use the related web sites. Although the students in this distance learning program are experienced using technology, there has remained a wide range of ability levels that affects their early success with course requirements. Aside from the technology factor, all broadcast instructors have compensated for the geographic distance through creativity in instruction and assessment. This creativity is evident in previously cited examples of: 1) problem-based learning projects which allowed students to impact local educational concerns, 2) collaborative grouping students across distance learning sites, 3) students' involvement in community research on the trends and issues affecting educators, 4) partnerships with school districts providing clinical experience, 5) peer observation and feedback of practice teaching sessions across sites, and 6) student-to-student evaluation of online coursework in workshop formats.

As a result of our distance education experiences, we would like to propose the following points for consideration when creating or improving a distance learning program:

1. The distance learning planning process should begin with a carefully selected team representing educational technology, curriculum development, teaching faculty, and broadcast production technicians. Team dynamics definitely correlate to broadcast course quality. The "team of experts" approach insures that the quality of input is exemplary, requiring no individual to venture outside their area of expertise in designing or producing the final

product.

2. The foray into distance education at the program level requires a significant institutional commitment, both financial and conceptual. Garnering support at the institutional or departmental level is a critical step that must occur before course design commences. Otherwise, unexpected expenditures of time and money will assuredly derail the project. For example, one week before broadcasting our fourth course the MCTP discovered that the anticipated free military network time was unavailable, requiring broadcast time to be purchased. Many such unexpected support problems arose; our distance learning effort used significantly more of time and money than was originally anticipated. We could have made concessions along the way but opted instead to place quality and longevity of course offerings as the priorities.

3. Selection of distance education faculty for broadcast should center on the criteria associated with effective teaching research (Berliner, 1996), not by the usual mechanisms which often involve seniority, tenure or workload. Unfortunately, we found a high degree of mediocre instruction among the faculty who were teaching TELETECHNET courses for the University. The MCTP faculty (mostly adjuncts who are practitioners in public schools) presented a much better quality pool of teaching and presentation skills for broadcast instruction. However, they required a significant amount of technological training in order to operate the broadcast equipment. During the first airing of MCTP classes, our much anticipated new technology and broadcast facility was not complete; the first four VTEL classes were broadcast out of one of the University's off-campus graduate centers in a makeshift virtual classroom. Instructors were required to operate all of the equipment without the aid of technicians. Despite this, instructional quality was good, although tape quality suffered due to human error and much editing was needed.

4. Specific synchronous and asynchronous components of distance learning should be analyzed for the purpose of supporting the idea that all quality distance instruction need not fall like pearls of wisdom from the mouths of broadcast instructors. Course web sites, along with their associated URL's, should be reviewed for clarity and support of course goals, objectives, and requirements. Discussion databases (threads) should stimulate meaningful student participation. Non-traditional, authentic assessment using web based resources should be a topic of considerable faculty research. Course instructors must be pushed toward valuing both formative and summative kinds of evaluation in order to support increased student accountability.

5. Issues concerning student support, while not fully explored here, are as essential to the design process as are the course competencies and assessments.

6. Most importantly, courses previously taught in traditional classroom settings cannot simply be "converted" into broadcast instruction; reductions in contact time and the addition of geographic distance require creativity in instructional and evaluative design. It is critical that students show application and mastery in ways that mirror reality. To accomplish this, students must actively take charge of course objectives that present opportunities to interact with the community, practitioners in the field, and the populations they will ultimately serve.

Summary

Distance education presents unique opportunities for faculty, staff and students to impact the learning environment and individualize learning. This process challenges the instructional paradigms that have become familiar and comfortable to most faculty; it also rests the burden for learning squarely on the shoulders of the distance education student. Instructional mediocrity is not an acceptable exchange for locational convenience. Heretical though it may seem to the ivory tower, only those faculty who are capable of the exemplary instructional technique of the master teacher should be allowed to present to the multitudes. Committing to high quality distance education means that we select the individuals with the most potential for improvement in the broadcast arena for intensive training. Additionally, evaluation methods for faculty should undergo close scrutiny and revision in order to emphasize effective teaching skills. Resources must be available to cover both anticipated and unanticipated instructional and production concerns. Distance learning opportunities have literally changed the face of education and opened educational doors to untapped student markets. Distance education programs that satisfy critical student needs have become the cash cows of colleges and universities world-wide, encouraging new for-profit players in the distance education market. The lure of organizational financial gain makes it tempting to quickly and haphazardly broadcast or post existing courses to the web without regard to effective technique. The conversion of courses from traditional to blended distance instruction requires monumental institutional, faculty and student commitment in order to maximize learning, retention and transfer.

References

Berliner, D. (1996). *Putting Research To Work in Your School. [Revised.]* Arlington Heights, IL: IRI/Skylight Training and Publishing, Inc.

Bloom, B., Madaus, G., Hastings, J.T. (1981). *Evaluation to Improve Learning.* New York: McGraw-Hill.

Elbow, P. (1986). "Trying to Teach While Thinking About the End and Evaluating Students More Accurately." In *Embracing Contraries: Explorations in Teaching and Learning.* New York: Oxford University Press.

Fisher, C.W., and Berliner, D. eds. (1985). *Perspectives on Instructional Time.* New York: Longman.

Hunter, M. (1982). *Mastery Teaching.* El Segundo, California: TIP Publications.

Joyce, B. and Weil, M. (1986). *Models of Teaching.* Englewood Cliffs, New Jersey: Prentice-Hall.

McGiven, J. (1994). Designing the learning environment to meet the needs of distant students. *Journal of Technology and Learning.* 27(2), 52-57.

Slavin, R., et al. (1986). *Using Student Team Learning.* 3rd ed. Baltimore: The Johns Hopkins Teams Learning Project Press.

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The Barefoot Teacher on the Telematic Highway - Serving Rural Communities in Kwa Zulu Natal

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Abstract: The Department of Community Nursing and the Open Learning Centre of Technikon Natal, and the community owned Community Development Programme are collaborating to provide online learning to rural and urban community nurses. The project involves the development of a multimedia pharmacology course, a virtual Internet class and the provision of information points (tele centres) in factories, rural police stations, refitted containers, and the like. This is a response to the acute need for training of community nurses operating under difficult conditions, with few resources, in primary health care settings in Kwa Zulu Natal.

Background and Problem Statement

The Natal Technikon's Department of Community Nursing, in association with Open Learning Centre at the same institution, has initiated an on-line certificate course, in a joint venture with the Community Development Programme.

In keeping with the larger objectives of the new South African National Qualifications Framework, i.e. to facilitate access to, and mobility and progression within, education, training and career paths, these departments support the rationale for restructuring South African education by the South African Qualifications Authority (SAQA). They recognise that telematic learning lends itself to Outcomes Based Education (OBE) in both style and philosophy.

"One of the saddest achievements of widespread public education in the twentieth century was the embedding of an attitude that education was about certificates and status but had little relationship to the way one lived one's life or did one's work. The attitude was intensified in apartheid education. This could even be reflected in critical and radical action, where we still find supposed change agents who know all the words about critical pedagogy and empowerment, but cannot suggest one practical way of enacting these abstractions in real places and lives of real people." (French 1997)

Therefore the Community Nursing project, which involves developing in-house courseware and a virtual classroom on the Internet, to meet the needs of the nurses stationed in remote areas - this in addition to the more usual teaching methodologies reflected in the existing pharmacology course. Urban community nurses based in factory clinics and urban primary health care points would also gain much from this distance course with regard to recent advances in distance education.

It is relatively easy to involve urban post-graduate community nurses in vital training required to equip them for significant changes in their roles - changes brought about by recent access for all South Africans to primary health care. Nurses in the rural areas, however, where there are few doctors and even fewer facilities, have little or no access to the information they need to carry out duties for which they have not been adequately prepared.

Apart from the problems of distance and suitable times usually associated with the need for online learning, there are few telephones, a rudimentary electrical power infrastructure, and a lack of computer literacy on the part of the nurses out in the rural areas. Access to service and repair of equipment is non-existent.

Crucial considerations are:

- the rural communities are fiercely suspicious of projects which they do not initiate themselves, for obvious reasons,
- once accepted and put in to place, the projects need to become self sustaining, and
- each project should contribute to the development of the community holistically.

The Community Development Programme Involvement

The Community Development Programme (CDP) operates a system whereby people with identified needs are formalised into small groups, and are then assisted to meet their needs by training, business mentorship and/or other forms of practical help. (Further details on the CDP can be found at http://cdp.co.za)

The CDP enjoys large-scale support by rural communities and CDP community facilitators will ensure acceptance of the Department Of Community Nursing's distance learning programmes.

Furthermore, the CDP is in a position to involve Telkom (telephone and Internet services) and ESKOM (electricity) at post offices, army bases and police stations for suitable placement of training centres.

Therefore, the CDP has been commissioned to identify and prepare suitable facilities for training the nurses, using already identified community information centres such as schools, post offices, police stations, factories and municipal offices. Each centre would be need to be equipped with a phone line, modem and computer and funding for Internet operating costs by the community itself with loans from the CDP National Trust Fund. These will be known as CDP telecentres.

Where there is extreme need and severe lack of facilities, the CDP is seeking corporate social responsibility funding to equip large shipping containers, already donated to the CDP, with necessary technology - a generator and cell phone, if needs be - as an information/training centre. The use of wireless Internet technology and cell phones are being investigated as a practical solution to the absence of telephone lines.

The Community Development Programme (CDP)

South Africans of European origin often find it difficult to relate to the concept of community life. They tend to be trained to be independent and self-sufficient. To rural Zulu's the concept of community based life style is obvious and normal. They share facilities, work together towards the common good, share a common identity and tend to be transparent with each other. This often creates a culture of rejection and suspicion when Western business practices intrude into rural life in the form of social corporate responsibility initiatives.

The Community Development Programme tries to bring the two philosophies together, so that communities can benefit from corporate involvement, and develop their own forms of commerce and trade without being disempowered. The CDP aims to educate and train participants to meet self-identified needs, and to provide access to corporate resources and infrastructures, so that communities and, ultimately, individuals can become financially independent and self-sustaining.

The programme endeavours to set in motion a process of economic and social empowerment by stimulating the creation, and equal distribution, of wealth by using participating communities' resources, abilities and consumer buying power to their own advantage. The participants are managed at a highly competent level, consulting with and being guided by qualified leaders in specific areas of expertise, employed in the geographical areas of the local communities.

The Open Learning Centre's Involvement

The Open Learning Centre at Technikon Natal, Durban, South Africa, has embarked on authoring the pharmacology course. The course will be made available to registered nursing students via the Internet, and on CD-ROM with accompanying work books.

The pharmacology course is the first of the in-house multimedia courses being developed, together with a course in basic physiology for the Human Biology department at Technikon Natal - also for the Faculty of Health. Both multimedia courses will undergo alpha testing in the first six months of 1999 with the help of currently registered students.

Currently, two virtual class sites exist on the OLC Web server, with several others in preparation. The Technikon Natal Community Nursing homepage will be in operation by early next year as corporate sponsorship has been found to run it. (Find the OLC homepage at http://olc.ntech.ac.za)

The Open Learning Centre's Operations at Technikon Natal

The mission of the Open Learning Centre (OLC) is to offer services, training and support that enable the academic departments of Technikon Natal to develop, implement and research their own telematic teaching and learning resources

Current services comprise:- on-line learning and computer aided instruction for students in key subject areas; development of courseware for academic departments; training and workshops on how to write and develop courseware; and telematic consultative services.

Lecturers from academic departments accompany their students and act as facilitators during weekly computer-assisted learning tutorial sessions. All sessions are time tabled and compulsory (i.e. attendance remains high throughout the year). Most of the sessions are credit bearing (i.e. academic departments allocate marks for completion of lessons on computer).

The OLC multimedia training room is used to prepare academics in the use of telematic teaching and learning technologies. For example, the training room is used by computer studies lecturer Parivash Khalili to teach the subject Operating Systems IV. Her B.Tech Information Technology students make use of the training room in order to access their virtual class on the World Wide Web. First year Residential Childcare students make use of multimedia resources on CD-ROM for the completion of a credit-bearing project.

The OLC's approach to courseware design is to train academics to become involved in "low level" courseware development that is easy to learn and do. OLC staff members co-ordinate the development process and are involved in "high level" development requiring scripting and other specialised skills. The OLC also provides access to courseware development resources such as scanners and software.

A number of workshops were delivered to lecturers during 1998, primarily on designing and managing virtual classes, and on using the World Wide Web as a teaching and learning resource.

The Department Of Community Nursing's Involvement

The Community Nursing Department is providing the learning material, evaluating the students and managing the pharmacology course. The Department has organised subject expert, Beverly Gold, to write the courseware content and accompanying literature. A full time staff member will operate the virtual class, workshops and online student assessments from the inception of the course in July 1999.

There are no successful distance-based programmes in this discipline in South Africa. There are a number of registered nurses working in varying sizes and types of occupational settings throughout the country, and further north, who are unable to access formal education and training in community health nursing.

If the pharmacology course proves successful, other primary health care courses will be developed along these lines. Nurses in the field are experiencing great problems with the introduction of free primary health care to all South Africans under the age of six. There is a severe shortage of skilled health professionals in the field and nurses have no access to the information they need on a daily basis, and little time or opportunity for upgrading their skills.

The Department Of Community Nursing At Technikon Natal

Courses are offered in occupational health nursing and primary health care.

In addition to Internet-mediated learning, video technology is also a medium that is being explored by this department. Plans have been put into place to translate one specific programme - a post-graduate course in occupational health nursing - into video and supporting workbook format by the end of 1999. While video material seems to be much more accessible as a means of delivery in the United States, the dollar/rand exchange and the different cultural context, makes it necessary for the department to produce its own video material. Extracts from these videos will be used in the interactive and online courses. The occupational health nursing course, recognised by the South African Nursing Council, has been chosen as it is not dependent on clinical instruction, nor does it necessarily require synchronous lecturer/student contact.

A small but comprehensive studio is being adapted in, and for, the department. Computer technology will be incorporated in the making of the videos. While only 50% of the target group is likely to have access to video machines, the programme is planned so that the workbooks will be sufficient to sustain the learning process. The videos will enhance the concepts and serve to motivate students and provide video clips for the CD-ROM courses. I

The Department of Community Nursing is extremely flexible and intends to exploit all the forms of communication to which students have access.

In Summary

It is our belief that we do not need to repeat previous technological learning curves. While we have our own unique learning to do in this field, we can simply plug in to the opportunities afforded by the expertise, wide experience and effective telematic technologies, developed by the United States, and simply get on with the urgent need to train our nurses. Our country's training and health care problems are truly desperate. This collaborative multi-modal project by the Department of Community Nursing, the Community Development Programme and the Open Learning Centre at Technikon Natal is one attempt to reach into the rural communities themselves and to bring equality of opportunity and equal access while providing health care.

Fortunately online learning/teaching technology is relatively cheap, suitable for our needs and readily available. From the point of view of experience in the field of telematic learning and teaching, we consider ourselves to be "barefoot", technologically speaking. By firmly directing our "barefoot" teachers and lecturers, and their students, on to the information super highway, we may be able to address some severe problems. Lack of training has lead community nurses to dispense antibiotics to children, which has resulted in them becoming deaf. We need to reach community nurses with the information and support they require in order to operate effectively under difficult and trying conditions as soon as possible.

References

-Book References
Hughes F.J. (1995) *Introduction To Interactive Multimedia Training Systems* Revision 2 University Of Surrey U.K. J.Hughes@surrey.ac.uk
Krüger J. (1997) *Introduction To The CDP.* Malvern South Africa: umSinsi Press http://www.cdp.ml.org
Palmieri P., Joosten V., Gilding J., Doddrell M., Burke J., Patrick K. (1998) *From Chalkface To Interface: Developing OnLine Learning* State Training System Government of Victoria Australia: http://www.eduvic.vic.gov.au
Engineering Outreach (1995) *Distance Education at a Glance* College Of Engineering University of Idaho USA http://www.uidaho.edu/evo

- Proceedings References
Uys P (1998) Towards the Virtual Class: Technology Issues from a Fractal Management Perspective: *Hydi Educational New Media Centre:* http:// www.wnp.ac.nz/hydi
Pete M. & Khalili P. (1997) Changing Roles of Lecturers in a Resource-based Open Learning Environment *SITE97* Association For The Advancement of Computing in Education,Charlottesville, VA.
Boyle T., Gray J.,Wendl B., Davies M. (1999) Computer Aided Learning *Department of Computing and Mathematics The Manchester Metropolitan University* http://www.doc.mmu.ac.uk/RESEARCH/res-rep/part1-3.html

- Journal References
French E. (1997) Ways of Understanding Integration in the NQF *The SAQA Bulletin* 2 (2), 21

Enhancing User Interaction on the Web

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Abstract: Interaction with the information on the Web pages has been often reduced to the selection of links. This is a serious limit to all the Web applications that require an effective interaction with the information. Among the others, educational applications suffer from this limitation. Recent technologies, such as D-HTML and Java, are changing this, and opening up new interactive solutions on the Web. In this paper, we report on the design strategies and technical solutions we have adopted to increase interaction in a Web-Based Instruction system. In particular, but not exclusively, we have focused on the learning needs of university students on the subjects of Urban Planning and Architecture. Specifically, the developed system allows authorized users to modify the informative hypertext network dynamically; in addition, users can handle and re-elaborate the information published on the web pages through specific "working tools". The paper mainly focuses on these tools, from functional and technical points of view.

Introduction

The World Wide Web is fast emerging as one of the most popular technologies for education, since it allows educational institutions to potentially reach millions of people located all over the world [De Bra 98]. Specifically, Web-Based Instruction systems, based on the integration of a rich hypermedia information system with powerful communication tools [Ibrahim et al. 95], have proved the instructional effectiveness of teaching and learning through the Web [Alexander 95].

However, some important features required for an effective use of the Internet in education are still missing from the Web. Limits concern many aspects of the Web, from presentation to interaction, from navigation to structure. Amongst the limits, we point out:

- The hypertext feature of the Web is extremely author-centered: users can only follow the hypertextual paths established by others (the page authors), but are not allowed modifying the existing links or adding new ones. Even if the available hypertextual navigation is a very important educational activity by itself, the impossibility of interacting with the information structure is a limit for educational applications.
- Information provided by the servers is usually in the form of web pages identical for all the students of on-line modules, rather than personalized pages.
- In html, information and its attributes (i.e., html tags) are mixed in the same document, thus making it difficult to work with automatic procedures aimed at elaborating the pure informative content [Andrews et al. 95].
- Interaction with the content of the pages is really poor, even though recent technologies provide interesting solutions.

More generally speaking, accessing a rich information environment -even if it is integrated with effective communication tools- is not a sufficient condition for expanding knowledge and stimulating learning. In fact, from a pedagogic point of view, learning requires "a deep understanding of the subject content" [Alexander 95] through a cognitive re-elaboration of the information [Colbourn 95].

Some design strategies can be adopted to overtake some limits of the Web. Research in this direction covers many aspects: from the hypertext organization of the information for individual learning paths [Oliver et al. 96] to the use of multiple media sources; from the publishing formats to the design of interfaces to reduce the cognitive overload; from the possibility of planning collaborative activities, to adaptive hypermedia [Brusilovsky 96] [De Bra 98], to the integration of tools which have proved particularly effective for stand alone educational hypermedia systems; and so forth.

In this paper we report on the design strategies we have adopted and on some specific tools we have developed to improve the interaction in a Web-Based Instruction (WBI) system. The system is aimed at supporting new didactic approaches to the subjects of Urban Planning and Architecture through the activation of on-line modules at University level.

Brief Introduction to the Developed WBI System and Innovative Features

The Web-Based Instruction system is organized in two "work areas" respectively named "Analysis Area" and "Design Area". The Analysis Area organizes-in a hypertextual way- the "external" information necessary for design activities in Architecture and Urban Planning (data on the town and on particular areas, the urban context for a new building, building regulations, administrative laws, formal and bibliography references, and so on).

The Design Area is directly aimed at some important phases of the design process in Architecture; it integrates Internet synchronous and asynchronous communication tools (e-mail, electronic discussion forums, videoconferencing, chatting) and tools to support the "control" of the project (virtual galleries, shared blackboard).

The Analysis Area represents an information repository for on-line educational modules activated on and managed through the system. The information in this area concerns, as a case study, the city of Palermo (Italy) and the design activities focus on, in particular, the sea front, in view of its future refurbishment.

In this paper, we do not present the Design Area in more details [Corrao et al. 99]; rather, we focus on the Analysis Area, by highlighting the interaction mechanisms implemented on it and their benefits in the educational field.

Actually, the system has been developed in such a way to provide different classes of users with different access facilities. Specifically, "students", "teachers" and "expert guests" can extend the information network interactively, by adding new pages and new (internal and external) links to the Analysis Area. "Students" can handle and re-elaborate the informative content of the pages; to this aim, we have implemented the "Working tools" which allow students to mimic effective traditional study activities. Changes operated on the Analysis Area can be "public", which means that they modify the original structure and content of the information network, and will be shown to all the classes of users; otherwise, changes are private to their author, so that they modify a "personalised" version of a web page in the Analysis Area (in addition, personalization can take into account some user's preferences, such as visualization preferences). Finally, "students", "teachers" and "tutors" can review the "study activities" performed during a specific study session (visited pages, operations on the page content, new added pages and links, and so on). We consider a "work session" as the set of operations performed by the user during two consecutive logs into the system.

Users gain access to the system through their Home Page [Fig. 1], corresponding to a personalized access point to the Design Area as well as to the Analysis Area.

Following, we report on the strategies we have adopted in order to implement the system.

Extending the Information Network

From a methodological point of view the possibility of extending the information network can improve learning through the construction of knowledge. This real interaction between students and the knowledge representation in the hypertext network is an important point towards a real and significant implementation of the Constructivist theory on the Web, by allowing for the development of personalized in-depth research sections [Schank 94]; the possibility of extending the information network allows teachers and expert guests to enrich the content of the system too. Finally, the privileges accorded to specific classes of users prevent guests from arbitrarily adding information to the system.

The possibility of extending the information network rises important theoretical and technical questions about the parameters to be fixed in order to guarantee a consistent growth of an on-line informative hypertextual network. Firstly, we have focused on a very precise model of the information domain, and imposed an a-priori organization of information; in such a way, new nodes can be immediately classified in some pre-defined category (and added to the right place in the network). Secondly, we have imposed some limits to the extension mechanism, both at information node and link levels; particular attention has been paid to the types of links users can add to the system. These constraints have been fixed in such a way to preserve the original structure of the network, yet allowing people to add new pieces of information. Moreover, it is extremely important to keep information about each node and link author, in order to guarantee source reliability. Finally, it has been necessary to provide system known users with mechanisms showing modifications to the network since their last access.

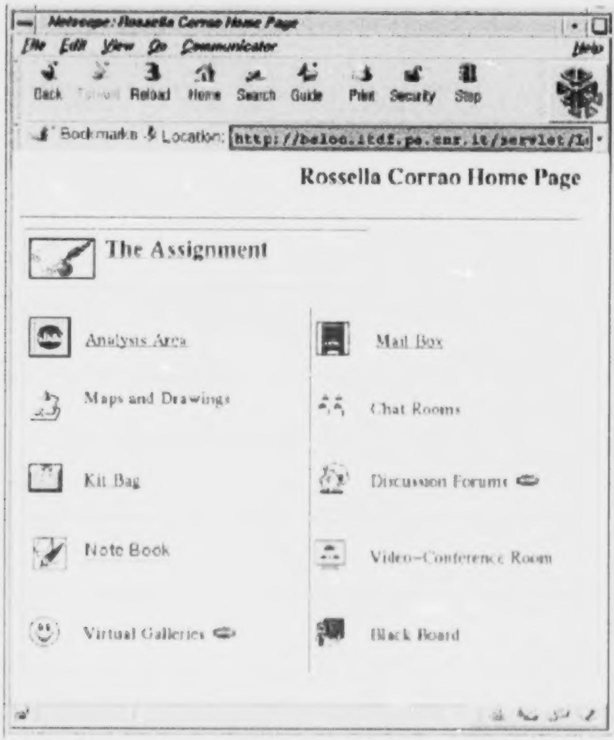
Netscape: Rossella Corrao Home Page
File Edit View Go Communicator Help
Back Forward Reload Home Search Guide Print Security Stop
Bookmarks Location: http://beloo.itdf.pa.cnr.it/servlet/
Rossella Corrao Home Page
The Assignment
Analysis Area
Mail Box
Maps and Drawings
Chat Rooms
Kit Bag
Discussion Forums
Note Book
Video-Conference Room
Virtual Galleries
Black Board

Fig. 1: The user Home Page is the personal entry point to system.

Specific tools have been developed to allow users to add nodes and associative links. By selecting a "New Page" button [Fig. 2], the user can add the content of the new page through a preformatted form; afterwards, s/he is guided to identify the category of information the new node is to be classified. Through the "New Link" button, the user can select the link anchor by interacting directly with the text on the page, through a common click-and-drag operation on the text; then, she is guided to select the link destination.

New added pages and links are public to all the system users, and not only to their authors, thus providing for learning activities based on cooperative production of knowledge.

Working on the Information Pages

The "working tools" sustain the user's attention at high level and develop his/her critical sense and his/her abilities to search for, extract and synthesize information. Specifically, we refer to the tools that allow the users to mimic traditional activities, through a series of stationery items like "Marker", "Foot-Note" and "Page-mark". These tools, together with the "Note-book" and the "Kit bag", enable the user to handle and manipulate the information in the web pages. Changes to the page content are private to the user who makes the modification. The philosophy of these tools is, in fact, the provision of mechanism for individual study strategies. In addition, making private modifications available to all the users could produce a chaotic representation of the information. The *"Marker" tool* allows parts of the text on the pages to be highlighted. The selected parts remain highlighted until the end of the on-line module; in addition, the user can decide whether and when to transform these selected parts into real informative documents by putting them into the "Kit bag". The *" Foot-Note" tool* allows the user to add notes, reference-marks and other information to the text of a page. The notes, which are for the private use of the user who created them, remain "attached" to the pages from one on-line work session to another. During first reading, the user can "mark" each page of the system s/he considers relevant to his/her studies by using the *"Page-mark" tool* (activated through a specific button [Fig. 2]); the user can navigate back

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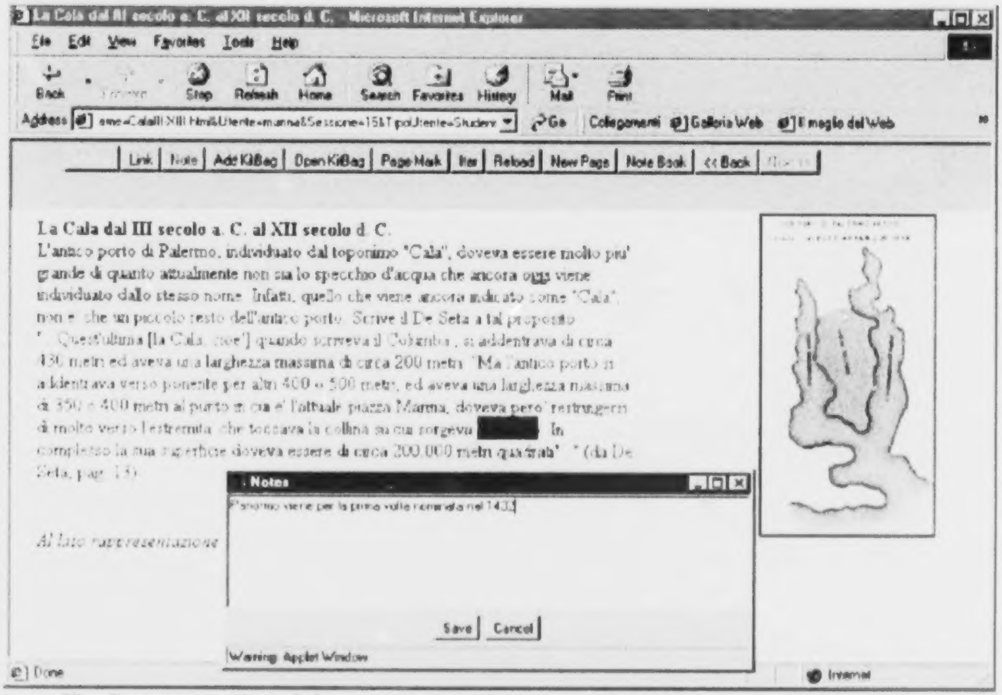
La Cala dal III secolo a. C. al XII secolo d. C. - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print
Address
Go
Collegamenti Galleria Web Il meglio del Web
Link Note Add KitBag Open KitBag Page Mark Iter Reload New Page Note Book << Back
Notes
Save Cancel
Warning: Applet Window
Done
Internet

La Cala dal III secolo a. C. al XII secolo d. C.
L'antico porto di Palermo, individuato dal toponimo "Cala", doveva essere molto piu' grande di quanto attualmente non sia lo specchio d'acqua che ancora oggi viene individuato dallo stesso nome. Infatti, quello che viene ancora indicato come "Cala", non e' che un piccolo resto dell'antico porto. Scrive il De Seta a tal proposito: "...Quest'ultima [la Cala, cioe'] quando scriveva il Colombo, si addentrava di circa 430 metri ed aveva una larghezza massima di circa 200 metri. "Ma l'antico porto si addentrava verso ponente per altri 400 o 500 metri, ed aveva una larghezza massima di 350 o 400 metri al punto in cui e' l'attuale piazza Marina, doveva pero' restringersi di molto verso l'estremita' che toccava la collina su cui sorgeva [redacted]. In complesso la sua superficie doveva essere di circa 200.000 metri quadrati" " (da De Seta, pag. 13).

Al lato rappresentazione

Panormo viene per la prima volta nominata nel 1433

Fig. 2: A screen shot of the system while the user is adding a note; the upper frame contains the "working tools" buttons and the buttons to extend the information network.

to the marked pages through the "Iter" tool (refer to [Controlling Oneself Study Path]) to study these pages in more detail. The *"Note-book" tool* works like a real note-book enabling the user to write down reflections, critical notes, and so on; for this reason it represents a collection of writing sheets. It is activated through the Note-book button [Fig. 2]. The user can access the Note-Book in the Design Area and pass through the different notes taken during the navigation across the Analysis Area. The tool "Iter" highlights the presence of footnotes on the pages. Finally, the *"Kit bag" tool* represents a kind of catalogue that the users carry with them during navigation through the system, and where they store pieces of information collected on this way around. The pieces of information in the "Kit bag" retain the reference to their original web page; therefore, it is possible for the user to go back to the page, and choose links to other parts of the system. Furthermore, users carry the "Kit bag" with them in the "Design Area". The user interaction with the "Foot-Note", "Marker" and "Kit bag" tools is extremely easy and rapid: once the corresponding button has been selected [Fig. 2], the user selects (through the click-and drag mechanism) the chunk of text which is, respectively, the anchor for the note, the text to be marked or the piece of text to be inserted into the kit bag.

Controlling Oneself Study Path

One of the most effective tools to help the users navigate through the information is the *"Iter" tool*: it shows the list of pages visited during each work session or since a date specified by the user. Unlike the "history" tool available in commercial browsers, the "Iter" tool keeps track of the operation performed on the pages through the tools described above. In particular, next to the name of every page, there are symbols to indicate the operation carried out by the user, so s/he may locate the information s/he considered important and return there directly. The same information can be accessed by the teachers and the tutors of the on-line modules, thus controlling and assessing the students' activities in the system. Non-technical teachers can, therefore, work with the system and perform assessment activities in a very easy way.

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It should be noted that some of the described activities could already be performed by using features of the browsers and of the most popular operating systems. However, these solutions are unsatisfactory because the mechanisms are not integrated into a single environment, they are usually separated from the learning/reading context (the informative content of the Web pages), and require a cognitive overload on the part of the learner/reader.

System Architecture and Implementation Overview

The implementation of the system is strongly centered on Java ™, both on the client-side and on the server-side. Specifically, Java Applets are used to host the text and to handle the user interaction; on the server side, the system is managed by a set of Servlets; to be more precise, servlets handle the mechanism necessary to provide the personalised pages to each registered user and to log all the user's operations. To this aim, an SQL-compatible Data Base is used to store information about the registered users (login, password, visualization preferences, and so forth), specific information belonging to each user (references to the file containing the personal notes added during the navigation, references to the information stored into the kit bag, and so on) and information on the modifications that each user has made on each page of the system. In particular, the system stores four different files for each page in the Analysis Area: the html page, containing the page layout, the file containing the pure text, the file of the public attributes (html formatting tags, link tags) and the file of the private attributes (to be more precise, there is one "private" file for each registered user). The separation between content, layout and attributes greatly improves the management of the personal versions of the pages. Finally, a Web Server, used to deliver html pages to the browser completes the system architecture.

When a registered user logs into the system, a specific servlet sends the user's Homepage to the client. As told before, the Homepage represents the personal entry point to all the parts of the system, included the Analysis Area; in order to guarantee the deliver of the personal pages of the Analysis Area to each user, all the URLs contained in the HomePage are modified in such a way to include its owner's ID. The ID will enable the servlets to identify the origin of each request. Specifically, when the client requires a page of the Analysis Area, an applet sends the modified URL to a specific servlet (ReqDocument), together with indication of the file containing the text as parameter; then, the applet sets up a *channel* which is used by the servlet to deliver the document. The particular servlet to be activated and the parameters (if required) are also included into the URL sent by the browser. The ReqDocument servlet builds the document by merging all the information contained in the four files reported before. When the document is received by the client, the applet interprets the tags included in the document, divides the text into the lines which will appear on the page, builds two arrays for each line containing the pure text (line_text) and the text inclusive of the tags (line_tag), and finally displays the document. The two arrays are necessary to handle the click-and-drag operation on the text.

The set of tags, which the applet is able to interpret, is a reduced sub-set of html tags together with new proprietary tags defined by the authors to encode the user changes to the text.

The selection of chunks of text on the page through the click-and-drag mechanism (which is central to many operations) is handled by the applet that hosts the text.

When a chunk of text is selected and the user operates on it through one of the tools described above, a communication process between the applet which handles the operative buttons [Fig. 2] and the applet hosting the text is started, so that the selected text is modified according to the operation selected by the user. In addition, the notification of the user action and of the words affected by it is sent to the server, so that the DataBase and the specific files are modified.

Some examples of the working mechanism for the most significant tools are reported. By selecting the Marker tool, the system modifies the background color of the selected text and communicates the event to the server; by activating the Foot-Note tool, the system opens a Java frame external to the browser, thus allowing the user to add the note [Fig. 2]; afterwards, it adds a symbol at the end of the selected text in order to anchor the footnote, and passes the event (including the note content) to the server; finally, by choosing Link button, the applet opens a Java frame external to the browser, allowing the user to select the page to be linked to the new created link, or directly writing the URL (internal and external URL's can be specified by the user); the new link is passed to the server.

The developed prototype is running on Windows NT platform equipped with Apache Web Server and Microsoft Access Database.

Conclusions and Future Developments

In this paper, we have proposed some design and technical solutions to improve interaction in a Web-Based Instruction system. Specifically, we have introduced the design strategies which allow users to extend the information network, and some "working tools" which can maximize the learning and reading processes and facilitate the recognition of the phases of knowledge acquisition. Even if the presented system concerns a specific subject, and is aimed at University studies level, the working tools should be considered as general solutions for educational systems. The Analysis Area can be substituted straightforwardly, thus widening the use of the system to different application fields. Anyway, a rigorous definition of the knowledge domain is necessary to allow for a consistent growth of the Analysis Area. Finally, the communication tools in the Design Area can be easily adapted for different educational contexts, and new tools can be integrated into it. The main limit of the Java based implementation is the restricted number of html tags the system recognizes in order to reduce the complexity of the interpretation work; consequently, an appropriate tradeoff between complexity and effectiveness should be investigated further. There are some other important developments we foresee for the presented system: firstly, it is possible for the servlet mechanism to work with distributed data base; secondly, some operations on the text which have been defined "private" can be straightforwardly made public, and vice versa, according to the user's decision and to the use context of the system. Finally, division between pure text and text attributes makes it possible the implementation of effective automatic procedures on the text.

References

[Alexander 95] Alexander, S. (1995). Teaching and Learning on the World Wide Web. *AusWeb 95*, Goald Coast, Australia.

[Andrews et al. 95] Andrews, K., & Kappe, F., & Maurer, H., & Schmaranz, K., (1995). On Second Generation Network Hypermedia Systems. *ED-Media 95*, Graz, Austria.

[Bowers 88] Bowers, G., (1988). *The cultural dimension of educational computing: understanding the non-neutrality of technolog.* New York, Teacher College Press.

[Brusiiovsky 96] Brusilovsky, P., (1996). Methods and Techniques of Adaptive Hypermedia, *User Modeling and User-Adapted interaction.* Kluvier Academic Publishers.

[Clements et al. 92] Clements, D.H. & Nastasi, B.K., (1992). Electronic media and early childhood education, *Handbook of research on the education of young children*, Mcmillian, New York.

[Clements et al. 93] Clements, D.H. & Nastasi, B.K., & Swaminathan, S., (1993). Young children and computers: Crossroad and directions from research. *Young Children*, 48 (2).

[Colbourn 95] Colbourn, C.J., (1995). Constructing Cognitive Artefacts: The Case of Multimedia Learning Materials, *First International Conference on Cognitive Technology*, Hong Kong.

[Corrao et al. 99] Corrao, R., Fulantelli, G. (1999) The Web to Support Creative Design in Architecture, *AVOCAAD. The Added Value of Computer Aided Architectural Design*, Brussels-Ghent, Belgium.

[De Bra 98] De Bra, P., (1998). Adaptive Hypermedia on the Web: Methods, Technology and Applications. *WebNet 98 Conference*, AACE, Orlando, Florida, USA.

[Ferreira 93] Ferreira, J. et al. (1993) Computer Technology for Land Use and Regional Planning, *3rd International Conference, Computers in Urban Planning & Urban Management*, GIT, Atlanta, GA, 285-287.

[Ibrahim et al. 95] Ibrahim, B. & Franklin, S., (1995). Advanced Educational Uses of the World Wide Web, *The Third International World-Wide Web Conference*, Darmstadt, Germany.

[Jaworski 97] Jaworski, J., (1997). *Java 1.1 Developer's Guide.* Ed. Sams.net, USA.

[Jonassen 94] Jonassen, D., (1994). Towards a constructivist design model. *Educational Technology*, 34 (4), 34-37.

[Klosterman, 99] Klosterman, R.E. (1999) Guest editorial, Environment and Planning. *Planning and Design*, 26, (3)

[Ligett 95] Liggett R.S. and Jepson W. H. (1995). An Integrated Environment for Urban Simulation. *Environment and Planning B*, 22, 291-302.

[Mayes et al. 92] Mayes, J.T., Kibby, (1992). The Learner's View of Hypermedia. *Learning Technology in the European Communities*, 53, 54-5.

[Kommers et al. 92] Kommers, P.A.M., & Jonassen, D.H., &. Mayes, J.T., (1992). *Cognitive tools for learning.* Springer-Verlag, Berlin, Germany.

[Manger 96] Manger, J.J., (1996). *JavaScript Essentials.* The Mc-Graw Hill Co..

[Naughton et al. 97] Naughton, P., Schildt, H., (1997). *Java: The complete reference.* The Mc-Graw Hill Co..

[Nielsen 90] Nielsen, J., (1990). *Hypertext and hypermedia.* Academic Press, Boston.

[Oliver et al. 96] Oliver, R. Herrington, J. Omari, A., (1996). Creating Effective Instructional Materials for the World Wide Web, *AusWeb 96*, Goald Coast, Australia.

[Pea 91] Pea, R.D., (1991). Learning through multimedia. *IEEE Computer Graphics & Applications*, 3 (3), 58-66.

[Schank 94] Schank, R.C., (1994). Active learning through multimedia. *IEEE Multimedia*, 1 (1), 69-78.

Ephemeral Paths on the WWW:
The Walden's Paths Lightweight Path Mechanism

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Abstract: Walden's Paths provides a mechanism for overlaying linear paths over World-Wide Web material. The path structure does not alter the pre-existing structure of the original material, but provides a means for organizing and contextualizing the collection of material. This paper first reviews the design of Walden's Paths and our experience with it. It then presents a new mechanism that enables ephemeral "lightweight" paths, which may be generated by a computer process.

1. Introduction

Walden's Paths provides directed paths over the World-Wide Web. It permits the specification of a *meta-structure* over the Web—a structure that brings together materials from widely-separated locations on the Web into a single, cohesive unit that leaves the original structure and content untouched and accessible. Although the function provided by Walden's Paths is somewhat similar to that provided by bookmark lists, the path provides the reader a stronger dynamic sense of context. Navigational context is provided through addition of user controls that enable traversal through the path while representing position within the whole. A path's author can add annotations that can be used to help the reader understand the page's material in the context of their own environment and experience.

The usefulness of paths (particularly linear paths) in organizing and contextualizing hypertextual material has been long-recognized [Bush 1945], and stand-alone implementations have existed since the 1980s [Trigg 1988, Zellweger 1988 and 1989]. Even so, implementing paths over the Web has required addressing novel issues, particularly issues related to Web materials' heterogeneous ownership and decentralized administrative control.

For some years we have been supporting K-12 classroom use of Walden's Paths in collecting, contextualizing, and communicating Web materials. We have reported on these experiences in earlier papers [Shipman et al. 1996, Shipman et al. 1997, Furuta et al. 1997, Shipman et al. 1998, Shipman et al. 1999]. Another project with similar educational goals has been described by Nichol [Nichol 1996].

These activities, in support of teacher-student, student-teacher, and student-student communication, require long-lived artifacts. Consequently, the publicly-available version of Walden's Paths supports temporally persistent paths—explicit authoring and annotation of paths are required; paths are "published" and appear in a centralized site directory; and issues of sharing and of path maintenance are topics of our current research.

Paths, however, have additional uses beyond that of supporting interpersonal communication. For example, they can be useful to an individual as a means of organizing inspection of discovered resources. Such applications require paths that can be reconfigured dynamically—paths that perhaps are generated initially by a computer process and then are manipulated and pruned as the reader inspects the results.

To increase our understanding of these applications, we have extended Walden's Paths to incorporate *ephemeral* paths—paths that provide a service upon creation but that are regenerated subsequently rather than retained. We consider this to be a "lightweight" path mechanism—lightweight not from the standpoint of implementation but from the standpoint of user expectation. Indeed, the implementation costs of lightweight paths are approximately equal to that of the earlier-mentioned persistent paths. Since they are not catalogued, no specific generally-available "handle" is provided; such paths are intended to be a personal, rather than public, artifact.

The next section of this paper contains a discussion of the relevant portions of the design, implementation, and use of Walden's Paths' publicly-available version. Following this, we return our attention to lightweight paths in section 3, presenting examples of their use in section 4. Section 5's discussion and conclusions complete the paper.

2. Walden's Paths (system view)

Figure 1 shows the Walden's Paths architecture, illustrating its major components (the WWW Browser and the HTTP Server are external to the Walden's Paths system). This paper will focus on modifications to the Path Server, so the other components will not be described; see our earlier papers or our Web site for their details.

The Path Server, implemented in C and invoked as a CGI program, takes the path information and produces a

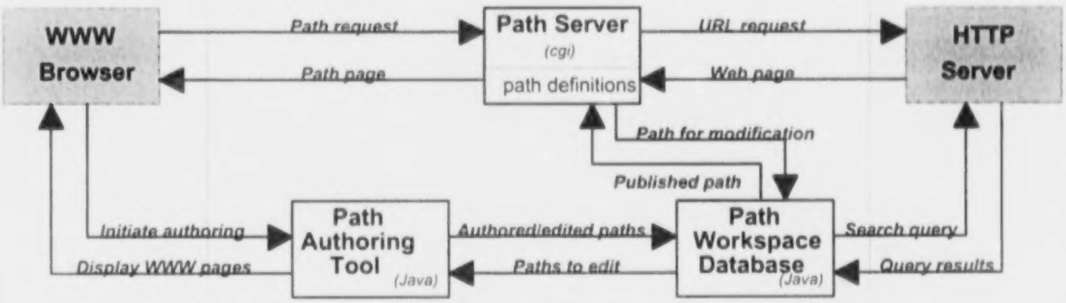
WWW Browser
Path request
Path page
Path Server
(cgi)
path definitions
URL request
Web page
HTTP Server
Path for modification
Published path
Initiate authoring
Display WWW pages
Path Authoring Tool
(Java)
Authored/edited paths
Paths to edit
Path Workspace Database
(Java)
Search query
Query results

Figure 1: The Walden's Paths Architecture

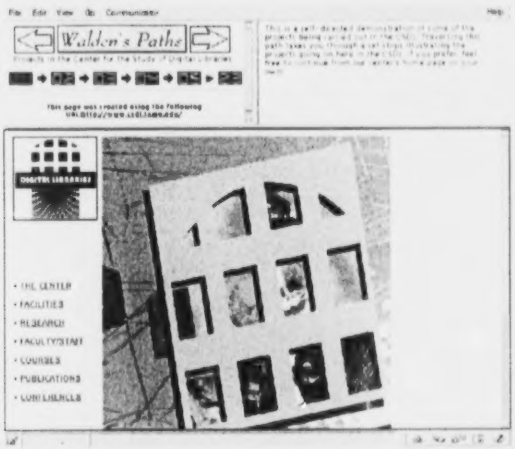
Walden's Paths
Projects in the Center for the Study of Digital Libraries
DIGITAL LIBRARIES
• THE CENTER
• FACILITIES
• RESEARCH
• FACULTY/STAFF
• COURSES
• PUBLICATIONS
• CONFERENCES

Figure 2: A stop along a path.

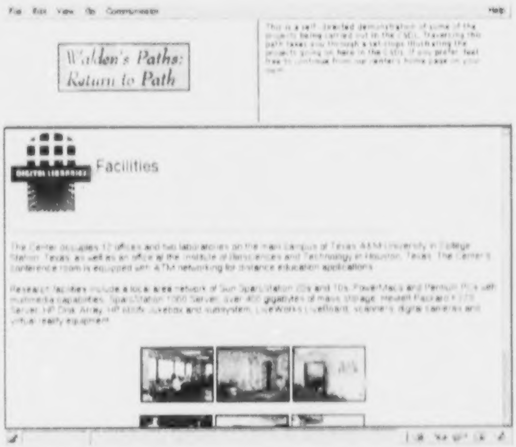
Walden's Paths:
Return to Path
DIGITAL LIBRARIES
Facilities

Figure 3: Going off the path provides reader with quick way back.

frame set with the control-flow buttons in the upper-left, the annotation in the upper-right, and the source Web page from the original site in the lower frame (see Figure 2). The control-flow frame provides the path reader with a sense of where they are in relation to the overall path, access to later pages in the path, and a pointer to where the source page comes from so the page can be viewed directly, without the Walden's Paths frames on top, if so desired.

Links in the source page remain active and, besides changing the contents of the bottom frame, change the upper-left frame to a "back to path" button so the reader can quickly get back to where he/she left the path. Figure 3 shows an example of this when browsing off of the page. Here, the reader has selected the "FACILITIES" link in the lower window shown in Figure 2.

The Path Server (as well as the other programs that make up the Walden's Paths system) is maintained in versions for Sun Solaris and for Windows NT. The paths displayed by the path server are not browser-specific or platform-specific, other than the requirement for frames support. In practice, current versions of Netscape and Internet Explorer are being used to access paths.

Early versions of Walden's Paths have been used by teachers taking part in summer teaching workshops and by teachers and students in eight high-school art and music classrooms. It is these experiences that have determined subsequent development, including the lightweight path mechanism.

In both workshop and actual classroom situations, one of the most striking outcomes of Walden's Paths use is how quickly the path technology fades into the background. Teachers and students find the path metaphor natural

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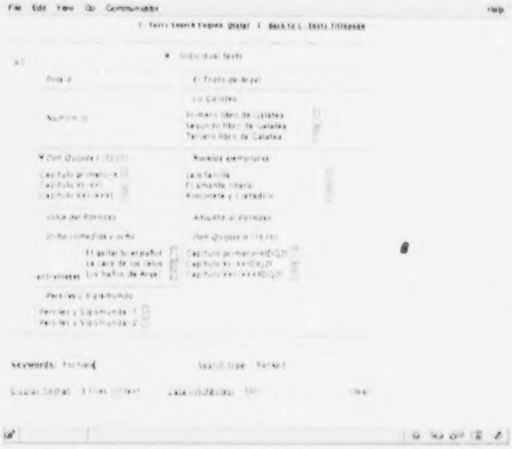

Figure 4: A query posed to the Cervantes search engine, seeking all occurrences of the term "fortuna" in the 1605 edition of *Don Quijote*, book one

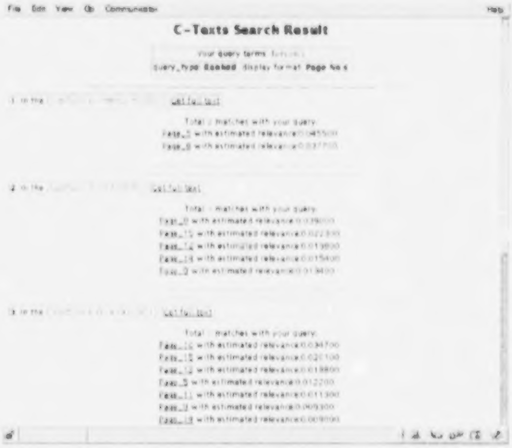

Figure 5: The result of the query, presented in traditional list format.

and, after a short period of learning about the system, quickly focus on the content within paths. This is a positive outcome as the ability for the technology to slip into the background in the classroom allows teachers and students to focus on what they are teaching/learning [Furuta et al. 1997, Shipman et al. 1999]

One observation from our experiences is that while teachers find paths easy to integrate in the classroom, they find it difficult to find time to author paths from scratch. Many of the paths used in the classroom were authored during training sessions rather than during the semester when they are spending most of their time in the classroom. It is this observation that has driven the need for greater authoring support for teachers and the more general notion of lightweight paths.

3. Lightweight paths

The persistent paths described in the previous section suggest entry specification, refinement, and annotation by a human author. The investment of time and effort is reflected in an expectation that such paths will be long-lived—that they will be catalogued, reused, shared, and maintained.

Generation of lightweight paths assumes the involvement of a computer process. They are intended to enable the application of Walden's Paths representations to computationally-generated collections of resources—results from queries, subsets or supersets of previously-developed collections, and applications customized for an individual or environment. Since lightweight paths are ephemeral, it seems unwise to support their fine-tuned tailoring or other large-scale investment of human energy in their specification.

Our lightweight path implementation fits into the general architecture of Figure 1. Lightweight paths use the same internal description format as persistent paths, but their entries are flagged as ephemeral and include information about their creation and retention times. Lightweight paths are registered with the Path Server but are not included in the path directory (i.e., the Path Server does not publish the path). A handle is returned to the caller, in the form of a URL, that can be used to access the path. A CGI program creating a lightweight path, can, therefore, generate an HTML page containing a redirection to this URL (i.e., the ONLOAD attribute of the BODY element), or it can carry out further processing to use the lightweight path in whatever way it wishes.

4. Applications of lightweight paths

In this section, we will examine some scenarios of lightweight paths in use.

4.1. Organizing the results from a search query

A group in our Center is developing a resource for humanities scholars of Miguel de Cervantes Saavendra (1547-1616), the author of *Don Quijote de la Mancha*. Cervantes, a figure of immense significance in Spanish culture, is credited as the inventor of the modern novel. His works and his use of language receive careful scrutiny by scholars.

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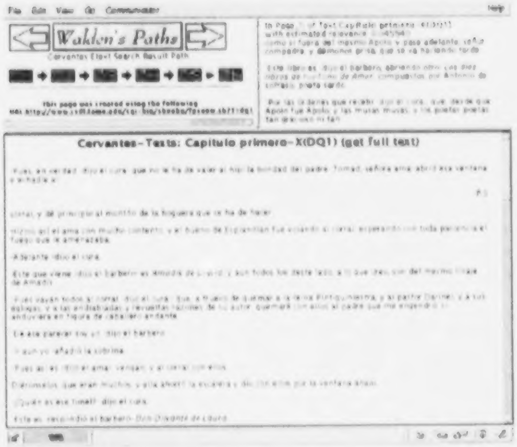
File Edit View Go Communicator
Help
Walden's Paths
Cervantes Etext Search Result Path
Cervantes-Texts: Capitulo primero-X(DQ1) (get full text)

Figure 6: The first result from the query, presented as a Walden's Paths entry.

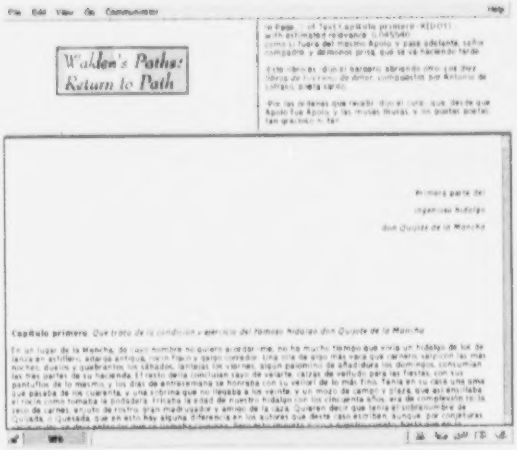
File Edit View Go Communicator
Help
Walden's Paths:
Return to Path
Capitulo primero

Figure 7: Traversing the provided link to see the entire text of the *Don Quijote* edition.

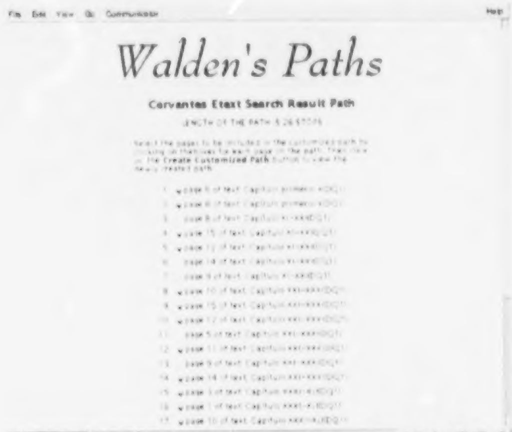
File Edit View Go Communicator
Help
Walden's Paths
Cervantes Etext Search Result Path
Create Customized Path

Figure 8: Selecting pages to retain from the path resulting from the earlier query.

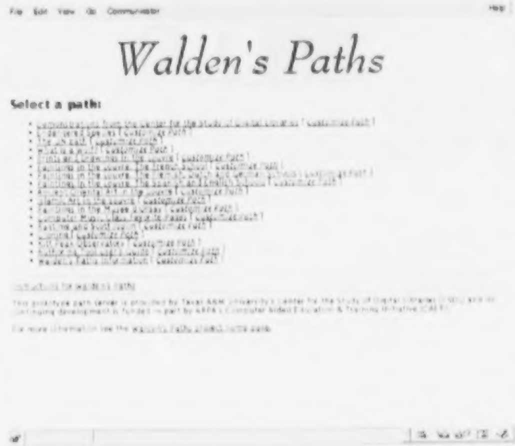
File Edit View Go Communicator
Help
Walden's Paths
Select a path:

Figure 9: Choosing "persistent" paths for elision.

This project maintains a set of Web pages at http://www.csdl.tamu.edu/cervantes/. One of the important components of that site is an on-line, searchable, edition of Cervantes' complete works. A scholar seeking, for example, the uses of the term "fortuna" in the first book of the *Don Quijote* would pose a query as shown in Figure 4. The traditional result of such a query is a list of responses, as shown as Figure 5. It is likely in this case that the scholar will next examine the use context for each occurrence of the term. This requires selection of an element on the list, examination of the page that is then displayed (the page on which the match has occurred), selection of the browser's back button, and finally selection of the next element on the list. Each new selection requires reorientation within the list, to determine first which element had just been selected and then to choose the next in the list. When the list is long, the selection of each element in turn becomes an error-prone operation, as it is quite easy to re-select an element already visited or to skip an element accidentally.

Figure 6 shows the result of the query, implemented as a lightweight Walden's Path. In this implementation, each search result becomes a separate stop in the path; here we are at the first stop. A brief summary is shown as the path annotation and the complete details of the match is shown as the stop's content (the matching words are highlighted in both places). Selecting the "next" arrow will take the scholar to the next match. Following the link in the content

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page results in an off-the-path traversal, shown in Figure 7, that displays the full text of the *Don Quijote* edition. Return to the path can then be accomplished using the standard Walden's Path mechanism with a single mouse click on the button in the navigation window.

Path elision

The previous scenario has assumed that all pages selected by the search are relevant to the questioner. What if irrelevant material has been selected, a likely outcome of an automatic selection process, and the researcher wants to pick and choose the items worthy of closer inspection? Path elision permits the selection of a subset of the path.

We view lightweight paths as the intermediary representation that permits implementation of a set of small "filters"—relatively simple bits of executable code that accept a path (either lightweight or persistent) as input and produce a modified (lightweight) path as output. One such filter permits a degree of path customization—allowing the selection of pages to retain and those to remove from a previously-generated path. As Figure 8 shows, this allows the modification of the previous search-generated lightweight path. The resulting path, also a lightweight path, would then be browsed with the standard Walden's Paths interface.

Such filters are useful when applied to persistent paths, as well. Figure 9 shows a modified directory listing for the persistent paths stored at a particular site. Application of the elision filter allows the reader to customize the path to be viewed. In this example, the reader might wish, for example, to focus on one of the projects of the several that are reported in the tour of our Center's activities.

4.2. Potential areas of application for lightweight paths

We are considering the development of additional, more sophisticated, path generators and path filters for applications that are inconvenient to implement with persistent paths. These applications of lightweight paths include those in which the dynamic nature of the underlying content make persistent paths impractical, those in which individually customized versions of a path are appropriate, and those in which the content of the path may vary depending on the specified or identified characteristics of the reader.

Paths over transient materials

Many forms of information are temporally-transient but persistently structured. The contents of a newspaper change on a continuing basis but the general form of the newspaper remains constant (e.g., the sections into which it is divided, the relative importance of the front and inner pages, the significance of placement of materials on a page). Weather satellite pictures provide a consistent set of information, but visible-light images are only useful for areas of the globe that are in daylight. We envision path generators that are able to locate the current versions of a set of resources, annotate them as appropriate to their context, and arrange them into lightweight paths for presentation.

Paths generated according to specified rules

Persistent paths have been used in creating on-line versions of course examinations (see [Shipman et al. 1998]). We envision applications that use lightweight paths to create customized tests from provided question pools using defined criteria. For example, some examinations for types of Federal licenses draw questions from a publically-available pool, with the distribution of the questions' subject areas specified by regulation. Other criteria might include randomization of order so that no two students had the same exact question sequence.

Paths generated in response to student strengths or weaknesses

A natural extension to testing mechanisms would be the use of the testing results to identify a set of tutorial material to aid the student in correcting deficiencies. We envision the presentation of such collections of material as being implemented by lightweight paths.

Template-generated paths

Customization of materials for students of differing skill levels may also be a possible application of lightweight paths. Here we envision a family of paths each with the same backbone structure, and with each drawing materials from a persistently-defined pool. However, the presentation of the specific topics along the path may be varied based on the individual student's age, grade level, interests, or other factors.

Randomly-generated paths

Finally, we envision applications that will benefit from randomly-generated paths. We have observed the use of persistent paths as a virtual "tour guide"—presenting an overview of an organization, perhaps. Randomized pages could be used, for example, to show selections from an art gallery's collection, or to show some tips about use of a software package.

5. Discussion and conclusions

Our experience with Walden's Paths has illustrated to us the strength and utility of applying meta-structures over the World-Wide Web. Our existing implementation provides a relatively simple linear path structure. This has had the desirable property of unobtrusively enabling the provision of guidance and context to readers.

While it appears that meta-structures have positive benefit, it is also clear that authoring meta-structure requires effort and attention. This observation is not surprising, as it is a characteristic of any creative and organizational activity. Nevertheless, it does suggest that the benefits gained from authoring should be in proportion to the effort expended.

In this paper, we have reported on a mechanism to allow application of paths in contexts in which the ephemeral nature of the application mandates against large-scale investment of an author's time. We have demonstrated that heuristic approaches to building meta-structure can be effective for some applications in this class. Our assumption is that the paths created using the lightweight path mechanism also will be ephemeral, and consequently will not be catalogued or retained for reuse. In applications suggesting reuse, therefore, the further assumption is that the resources required to rebuild a lightweight path should be similar to the resources required to locate a path in a persistent collection.

Consequently, we have provided mechanisms at two ends of the persistent-ephemeral spectrum. However, the categorization of many documents and structures ranges between fixed and fluid, influenced particularly by the application. Buckland [Buckland 1997] illustrates this clearly in surveying the differing notions of how to define "document". Levy [Levy 1994] considers similar issues in his discussion of literary hypertextual presentations, and Levy and Marshall extend these thoughts into the Digital Library domain [Levy and Marshall 1995].

We see similar influences in the future directions of our project and expect to extend our model of persistent-ephemeral paths as it develops. We are examining a number of such extensions, already. These include extension of the directory mechanism to reflect categorization of paths along multiple dimensions, one of which may be the required temporal persistence of the path. We also see potential for generalizing our model of the authoring process, using lightweight paths to represent intermediate versions of a path while under development.

References

[Buckland 1997] M.K. Buckland, "What is a 'Document'?", *Journal of the American Society for Information Science*, 48, 9 (September 1997), pp. 804-809.

[Bush 1945] V. Bush, "As We May Think", *Atlantic Monthly*, July 1945, pp. 101-108.

[Furuta et al. 1997] R. Furuta, F. Shipman, C. Marshall, D. Brenner, and H. Hsieh, "Hypertext Paths and the World-Wide Web: Experiences with Walden's Paths", *Hypertext'97 Proceedings*, 1997, pp. 167-176.

[Levy 1994] D.M. Levy, "Fixed or Fluid? Document Stability and New Media", *European Conference on Hypermedia Technology 1994 Proceedings*, ACM, 1994, pp. 24-31.

[Levy and Marshall 1995] D.M. Levy and C.C. Marshall, "Going Digital: A Look at Assumptions Underlying Digital Libraries", *Communications of the ACM*, 38, 4 (April 1995), pp. 77-84.

[Nichol 1996] D. Nichol, "Footsteps: linearsing hypertext", 1996. http://www-interact.eng.cam.ac.uk/footsteps/footsteps.html

[Shipman et al. 1996] F. Shipman, C. Marshall, R. Furuta, D. Brenner, H. Hsieh, and V. Kumar, "Creating Educational Guided Paths over the World-Wide Web", *Proceedings of ED-TELECOM 96*, pp. 326-331.

[Shipman et al. 1997] F. Shipman, C. Marshall, R. Furuta, D. Brenner, H. Hsieh, and V. Kumar, "Using Networked Information to Create Educational Guided Paths", *International Journal of Educational Telecommunications (IJET)*, 3, 4 (1997), pp. 383-400.

[Shipman et al. 1998] F. Shipman, R. Furuta, D. Brenner, C. Chung, H. Hsieh, "Using Paths in the Classroom: Experiences and Adaptations", *ACM Hypertext '98 Proceedings*, 1998, pp. 267-276.

[Shipman et al. 1999] F.M. Shipman III, R. Furuta, H. Hsieh, L. Francisco-Revilla, U. Karadkar, A. Rele, G.V. Shenoy, D.A. Brenner, "Using the Internet in the Classroom: Variety in the Use of Walden's Paths", *EdMedia '99*, 1999, pp. 335-340.

[Trigg 1988] R.H. Trigg, "Guided Tours and Tabletops: Tools for Communicating in a Hypertext Environment", *ACM Transactions on Office Information Systems*, 6, 4 (October, 1988), pp. 398-414.

[Zellweger 1988] P.T. Zellweger, "Active paths through multimedia documents", *Document Manipulation and Typography* (Proceedings of the International Conference on Electronic Publishing, Document Manipulation, and Typography, Nice France, April 20-22, 1988), Cambridge University Press, 1988, pp. 19-34

[Zellweger 1989] P.T. Zellweger, "Scripted Documents: A Hypertext Path Mechanism", *Proceedings of the ACM Hypertext '89 Conference*, 1989, pp. 1-26.

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Communication and Collaborative Work via Intranet Technologies

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Abstract: This paper presents a set of advanced network services developed to support the administrative operations and the collaboration of different scientific groups within the University of Patras. The system developed is exploiting Intranet technologies enabling asynchronous and synchronous cooperation, manipulation of information from heterogeneous sources, security and easy administration, providing in parallel advanced communication facilities. This is one of the first attempts made in national level in Greece, in order to support a campus to increase the effectiveness of workgroup, departmental, and cross-functional communication by giving the users the possibility to use advanced network services. More specifically, we describe the services developed, the whole system architecture and present the security issues faced in the implementation of the project as well as the introduction of the whole system to the users.

1. Introduction

Today, the Internet and the technologies it has spawned have altered the way people think and work and created a major new industry virtually overnight. For today's knowledge workers, the Web is a network of computers navigated with "browser" software that links them instantly to vast repositories. The result is a revolution in the way organizations communicate with the outside world and - perhaps more importantly in the near term - in the way they distribute and share information internally.

By using common Internet protocols, or core technologies, in conjunction with their own applications, corporations can easily communicate, distribute information and facilitate project collaboration across the entire organization while keeping unauthorized users out.

A recent study by NetworkWorld found that 89 percent of organizations sampled already have implemented or will implement an intranet strategy in the next 12 months. Internal webs have become so popular that installations of servers limited to internal use is outpacing that of external web servers by better than five to one.

Some of the key advantages of Intranet technology are the following [Bernard 96]:

- Web technology is inexpensive. The basic system configuration consists of a server hardware platform/operating system and WWW server software. On the user side, an inexpensive browser is needed to navigate the information.
- A second driving force behind the rapid growth of Intranets is that the technology is extremely intuitive and easy to use without much training. Users use hypertext links to search for and access text, graphics, audio or video, all organized into home pages.
- Another appealing feature of Intranets is security. Sensitive corporate data are protected from the outside world by security software known as firewalls. When anyone on the outside tries to get into an internal web, the firewall requests a password and other forms of identification.
- Finally, and perhaps most importantly, Intranets solve the problem of interoperability. Web servers are based on open technology and common standards, allowing Intranets to connect all the different types of computers on a network, whether they are PCs, MACs or Unix workstations.

In this paper, we present an Intranet-based, database-oriented CSCW system implemented around the 'shared workspace' notion [Grudin 94]. The workspace comprises asynchronous and synchronous cooperation and communication tools. The use of these tools is restricted (password controlled) and can be accessed via standard, unmodified web-clients using the login/password authentication scheme. Within the boundaries of a workspace the user can manage and share with other members of the workspace different kinds of information, including:

- A folder-file repository, in which the users may transfer various types of files from their local store into a shared repository (uploading) or retrieve files from the workspace to their local system (downloading).
- A discussion forum (bulletin board). A shared location for posting announcements supporting follow-up messages (that is, replies to existing messages).
- A real-time Chat session. A synchronous communication, Java-based, client/server application integrated in the web-browser. The members of the workspaces can communicate in real time via a chat session belonging exclusively to the workspace, a session similar to the well-known IRC chat sessions.

This paper is organized as follows: Section 2 provides the details of the system architecture, specifically the construction of the databases and its functional modules. In section 3 the security issues for the smooth operation of the whole system is addressed. The last section summarizes conclusions elicited from our work and presents future work issues.

2. System Architecture

The university has various departments, laboratories and services that administer and maintain their own databases. These databases are completely independent of each other, in which case each can be treated as a single entity.

However, if multiple databases are going to be connected to each other through an intranet, then several issues of inter-connectivity, permissions, and administration arise. An intranet that contains inter-connected databases requires careful planning, considerable co-operation and co-ordination.

The most critical component of such an intranet infrastructure is the main server which is responsible for the co-ordination of the network. The selection criteria for the server platform in our case included:

- High performance
- Scalability (the ability to expand as needs change)
- Powerful operating system administration and management tools
- High throughput hardware systems for both networking and storage media
- Strong security features

The server platform houses a variety of modules to provide various services to intranet users. The main modules of the intranet are [Fig. 1]:

1. World Wide Web module
2. Database module
3. Communication module
4. Search module
5. Multimedia module

Each of these modules is installed on a single machine except from the database server, which has a distributed architecture.

2.1 The World Wide Web Module

This is the basic module [December et al. 96] that brings together the power of the intranet. This module is comprised of a WWW server which allows clients access to organisational information by facilitating information publishing, application execution, and data retrieval.

The Web server software package is Microsoft's Internet Information Server 4.0, a server that provides a comprehensive set of set-up, management and administration facilities. The Web server uses the HTTP (HyperText Transport Protocol) for the transfer of data (text, images and sound) to/from the network. The use of HTTP allows the communication between the server and the client (a WWW browser) via a socket connection established by the TCP/IP protocol. The ever-growing use of multimedia technology for the construction of web pages requires the adoption of several multimedia standards such as Active X and ShockWave. A number of plug-ins is also required for the browsers to have the capability to handle multimedia-rich files.

2.2 The Database Module

Most Intranet implementations are using flat files or proprietary systems for storing data and information. However, since the organisation already had many large databases installed and operational in different departments, it was necessary their integration to a larger management system with a distributed architecture.

A main database server is used to co-ordinate access rights to data through applications written to access the databases both form the WWW module and from existing in -house applications. Extensions to standards such as ODBC (Open Database Connectivity), and ISAPI (Internet Server Application Programming Interface) enable the Web Module to interface to the various databases.

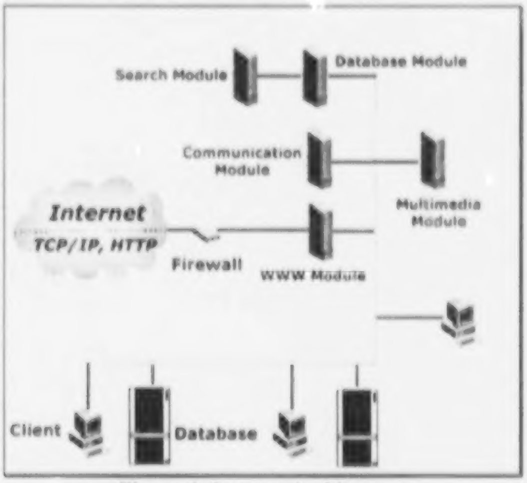

Figure 1. Intranet Architecture

2.3 The Communication Module

The Communication Module [Stallings 88] facilitates information exchange between users of the intranet. More specifically it provides functionality for:

- *Multimedia Electronic Mail (e-mail)* - a messaging system for exchanging information between users. The mail services use a variety of protocols including SMTP (Simple Mail Transport Protocol), MIME (Multimedia Interface Mail Extensions), POP3 (Post Office Protocol) and IMAP4. These protocols deliver essential e-mail features including:
  - message tracking, return receipt, accurate attachments and in box synchronisation regardless of whether the users are located inside the Intranet architecture
  - HTML editors for creating rich, hyper-linked messages
  - support for messages originating from a variety of software packages
- *Bulletin Boards* - A "Post-it™ Notes" system for disseminating information to a group of users.
- *Discussion Groups* - A forum for exchanging ideas and engaging in discussions on various topics.
- *Chat Rooms* - A place where users can interactively "talk" to each other
- *Video-Conferencing*: the Local Area Networks is connected to hubs bringing sufficient bandwidth for multi-user conferencing. Furthermore, special protocols such as Real-time Transport Protocol (RTP) are used to facilitate real-time transmission of audio, video, and data. This framework incorporates several codecs including MPEG, H.261 and GSM.
- *Remote Access* - Allow users remote connection to the corporate intranet through dial-up networking.

The Communications Module works in conjunction with the WWW Module to provide a seamless means for users to interact with the intranet and with each other. The Module also provides secure connectivity through e-mail gateways to the outside world. Users can send and receive e-mail messages to people all around the world using their Web browser or other e-mail software package.

2.4 The Search Module

The Search Module is actually an advanced search engine that uses indexing mechanisms to provide users with a means for finding and retrieving information form the Database Module. The search engine catalogs and indexes information being published on a distributed database system. As new information is added to the intranet databases, the search engine updates its indices to reflect these changes.

The most critical aspect of the search mechanism is the ability of the system to provide search results in a fast, efficient, and error-free manner. Speed becomes an important issue as the size of the intranet grows.

2.5 The Multimedia Module

The Multimedia Module provides support for high speed streaming media such as video and audio. It is comprised of a multimedia servers which uses high speed links to provide intranet users access to live or pre-recorded multimedia content.

One of the most compelling applications for the Multimedia Module was to provide support for live audio and video communications for the support of videoconferencing or collaboration tools. Users can interact with each other through sight and sound rather than using text-based messages.

Another application for this module was to provide on line and off line teletraining. Users can access video catalogs of seminars and training classes and view them using their browser software or other multimedia clients.

3. Intranet security issues

3.1 Basic Concepts

The transfer of confidential information through the Internet poses the need for advanced security measures from any unauthorized Internet user. The need for secure channels of communication and different levels of security is a major problem during the design of every Internet-based transaction system. This section will give guidelines on how to secure Internet connected systems from both inside or outside intruders.

There are four categories that security is applied [Schneier 96]:

- *System Security*

  Is the operating system secure? Have all patches been applied to enhance the system's security? Are all security "holes" been closed? Do only authorized users log in to the system? Have guest accounts been disabled? Have directory and file read/write access restrictions been applied correctly? In our systems all the above questions are answered with "YES" in order to achieve system security.

- *Communications Security*

  The data between computers are transferred from/to servers to/from clients and vice versa. If those data are transferred without encryption it is possible for anyone to sniff them, log them to a file and then use them in any hazardous or offensive way.

- *Data Security on End-Systems*

  After the two above actions we should pay attention to secure the data that arrive to the end system and are stored to its hard disc. Those data should be encrypted by the receiver-program before being stored as a file to the hard disc. One common way of further enhancing the security on end systems is to firstly cipher the data and then store a piece of that information on the hard disc ciphered and the rest data be transferred by secure E-mail to another system.

- *Authentication and Authorization*

  The authentication is the process of identifying which user wants to access a server mostly by a combination of username and password pairs [Tari et al. 97]. After successful authentication, the user can only use resources that are explicitly assigned for him to access. Roles or groups (e.g. operators, administrators, staff) have been assigned to all users so specific services can be accessed by specific groups.

3.2 The SSL Protocol Specifications

The SSL Protocol is designed to provide privacy between two communicating applications (a client and a server). Second, the protocol is designed to authenticate the server, and optionally the client. SSL requires a reliable transport protocol (e.g. TCP) for data transmission and reception. The SSL protocol is a protocol layer, which may be placed between a reliable connection-oriented network layer protocol (e.g. TCP/IP) and the application protocol layer (e.g. HTTP). SSL provides for secure communication between client and server by allowing mutual authentication, the use of digital signatures for integrity, and encryption for privacy.

The SSL protocol provides "channel security" which has three basic properties:

- *The channel is private.* Encryption is used for all messages after a simple handshake is used to define a secret key.
- *The channel is authenticated.* The server endpoint of the conversation is always authenticated, while the client endpoint is optionally authenticated.
- *The channel is reliable.* The message transport includes a message integrity check.

The protocol is designed to support a range of choices for specific algorithms used for cryptography, digests, and signatures. This allows algorithm selection for specific servers to be made based on legal, export or other concerns, and also enables the protocol to take advantage of new algorithms. Choices are negotiated between client and server at the start of establishing a protocol session. The SSL session is established by following a handshake sequence between client and server. Once an SSL session has been established it may be reused, thus avoiding the performance penalty of repeating the many steps needed to start a session. For this the server assigns each SSL session a unique session identifier which is cached in the server and which the client can use on forthcoming connections to reduce the handshake (until the session identifier expires in the cache of the server). The elements of the handshake sequence, as used by the client and server, are: a) Negotiate the Cipher Suite to be used during data transfer; b) Establish and share a session key between client and server; c) Optionally authenticate the server to the client; d) Optionally authenticate the client to the server.

3.3 Firewalls

An important component of an overall security strategy is the deployment of firewalls. Although they cannot prevent data-driven attacks, they provide control of traffic that enters and exits the corporate web site. Traffic can be accepted or rejected based on application type and source address. Some key features of a firewall are:

- Regulation of the type of traffic comes in and goes out of a network. At the most basic level, a firewall lets some traffic in and keeps other traffic out. How the firewall does this and what other security features it offers - differentiates it from other firewall products. Firewalls provide a single point from which to audit for intruders and log access attempts and dropped connections
- Hiding of the corporate Intranet. By making network address translation, a firewall system can hide the IP addresses and domain names of internal systems from the Internet. This provides benefits in keeping the private network, safe from public eyes and also enables users to use IP addresses internally that may not be valid on the public Internet.

There are three basic types of firewalls: packet filters, circuit-level gateways, and application gateways. Of course there are also hybrid firewalls which can be combinations of all three [Chapman et al. 95].

Packet filter gateways are usually comprised of a series of simple checks based on the source and destination IP address and ports. They are very simple to the user since the user will probably not even realize that the checks are taking place. However, that simplicity is also their biggest problem: there is no way for the filter to securely distinguish one user from another. Packet filtering firewalls can be router-based or bridge-based. In general, this type of firewall examines each packet as it enters the router and decides whether or not to allow it in to the network, based on administrator-defined rules. Because packet filters examine one packet at a time, they are best for filtering stateless protocols, that is, protocols that can be examined one packet at a time without relation to what has gone before. HTTP is stateless, whereas FTP is stateful.

Circuit-level gateways are very similar to packet filters except that they operate at a different level of the OSI protocol stack. Unlike most packet filters, connections passing through a circuit-level gateway appear to the remote machine as if they originated from the firewall. This is very useful to hide information about protected networks. "Socks" is a popular de-facto standard for automatic circuit-level gateways. Application gateways represent a totally different concept of firewalls. Instead of a list of simple rules which control which packets or sessions should be allowed through, a program accepts the connection, typically performs strong authentication on the user which often requires one-time passwords, and then often prompts the user for information on what host to connect to. Hybrid gateways are ones where the above types are combined.

One difficulty with packet filters is that, if they conform to the rules Internet packets are admitted to the internal network without modification. By contrast, application gateways often use proxies to translate packets, ensuring that no raw packets enter the internal network. Knowing how many packets are rejected and where they are coming from is important, so select a packet filter that provides these logging capabilities. While packet filters examine each packet for its source, application gateways provide finer-grained access control of each application type.

The strictest method for setting-up a firewall is to deny all access that is not explicitly permitted. A more liberal policy is to permit all access that is not explicitly denied. The strictest rule is also the most difficult to live with, in the case of an application gateway. Each application that is permitted must have a proxy. A proxy is software that runs on the firewall and appears to internal users to be a host and appears to the Internet to be a client. The proxy translates packets between the two applications In the case of E-mail a good proxy will strip out internal host names from mail headers and replace them with the firewall's host name, in keeping with the policy of hiding internal host names and IP addresses.

4. Conclusions & Future Work

One of the most critical stages of the whole project is the introduction of the services to the users. International surveys have shown that the gradual and easy introduction of the system to the users as well as its interactivity and functionality are some of the major factors that will determine its acceptance [Ponta 96]. Moreover, considering that the final system is used for most of the educational procedures within the campus, several pedagogical aspects are already taken into account.

The final purpose was to develop a highly interactive system to support efficient and effective user functionalities, taking advantage of the new Intranet multimedia infrastructures available based on a friendly and easy to use user interface. Our work showed once more that the introduction of new network services is not mainly a technological problem. The development of the services, their integration and introduction to the users has to follow a well-defined, user oriented implementation plan.

The implementation of the Patra's University Intranet has resulted in:

- Money Savings by offering a great potential for cost savings over existing networking and collaborative technologies.
- Time Saving: The timely implementation of a collaborative application is faster using Intranet techniques.
- Standardization of Data Access: The availability of web browsers on every major operating platform is making it possible to provide high impact graphics access to all users, regardless of their platform. By using the HTML coding, which is a common standard, collaboration is easier within such environments. TCP/IP protocols provide the means to transmit such uniform data to large number of dissimilar platforms.
- Wide area communications: Web-based Intranets are ideal for developing corporate communications among geographically dispersed locations.
- Improvement of the information flow from/to the University.

The target of the project is a pool of advanced services focused on the user needs for effective information retrieval and spreading, and the use of alternative education tools. An extensive statistical process on a per service basis shows the network use and utilization and reveals potential modifications for improving the Intranet network structure and its services.

5. References

[Bernard 96] Bernard R., «*The Corporate Intranet*», Wiley Computer Publishing, 1996.

[Chapman et al. 95] Chapman B., and Zwicky E., «*Building Internet FIREWALLS*», 1st Edition, O' Reily, 1995

[Schneier 96] Schneier B., «*Applied Cryptography*», 2nd Edition, Wiley, 1996

[December et al. 96] December J., and Randall N., «*The World Wide Web Unleased*», Sams Publishing, 1996

[Stallings 88] Stallings, W. (1988). «*Data and Computer Communications*», 2nd Edition, MacMillan Publishing Company

[Grudin 94] Grudin J., «*CSCW: History and Focus*», IEEE Computer 27:5, 1994, pp. 19-26

[Ponta 96] Ponta D., Scapolla A.M., Taini M., «*Telematics for Education: The Design of a Distributed Computer-Based Collaborative Learning System*», Proceedings of ED-TELECOM 96, pp. 252-257

[Tari et al. 97] Tari Z., and S. Chan, «*A role-based access control for intanet security*», IEEE Internet Computing, Vol. 1, No. 5, September/October 1997, pp. 24-34

E-commerce Across International Borders: A Personal Experience

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Abstract: E-commerce has gone beyond the stage of discussion and it is now being broadly implemented. Within the past year, a large number of companies in the US have become e-commerce enabled. Furthermore, a lot of networking infrastructure exists worldwide which makes possible the easy access of e-commerce services in the US from abroad. This paper presents an experiment in international telecommuting via the Internet. It discusses the current state of e-commerce solutions and Internet communications, and points out areas where improvements could be made.

1. Introduction

In the past few years, the use of the Internet has gained widespread popularity. According to a particular market survey, by mid-1998 there were 100 million Internet users worldwide [CommerceNet 1997]. The Internet is a global phenomenon that eliminates international borders. A user in New York City can access an Internet server located around the corner in the same city or across the planet in New Zealand in a matter of seconds without knowing (or really caring) where it actually is. This is the real power of the Internet: it can shrink the globe down to the size of a computer keyboard, making everything reachable in just a few keystrokes.

Along with the big growth of the Internet users, electronic commerce (e-commerce) has also begun gaining momentum, as a large number of companies have espoused this new paradigm of doing business. The belief is that e-commerce will improve overall profitability by increasing productivity and market penetration while reducing operating costs. As a result, e-commerce has evolved beyond a concept on the drawing board into a reality that can now affect the everyday life of each one of us.

The term electronic commerce has different meaning among different people. Some interpret it as a fully or almost fully digital commercial activity. Others prefer to view it as a traditional commercial activity supported more or less by electronic technology. We suggest that e-commerce encompasses both of the above. The commercial activity can be between businesses, between businesses and consumers, between businesses and government agencies, and between citizens and government agencies.

Of the 100 million current Internet users, more than half (i.e., 58 million) reside in the US and Canada [CommerceNet 1997]. The popularity of e-commerce seems to be much higher in this region of the world, as well. However, the vision of an electronically interconnected world where e-commerce is going to see explosive growth across international borders assumes a global adoption of e-commerce not only by the consumers of the highly industrialized nations of North America but also of Europe and many of the developing nations.

Most users of the Internet have communicated via e-mail and many have telecommuted or engaged in some form of e-commerce such as online banking, buying or selling stocks, purchasing books, placing an ad, and so forth. But how many have considered depending entirely on the Internet for an extended period of time to take care of all work related functions and every day personal business?

I have been a researcher at the IBM T.J. Watson Research Center, Yorktown Heights, New York, where for the past three years I have had the responsibility of managing a number of research activities in the highly competitive area of microprocessors. A department reorganization at the end of the year opened a window of opportunity for me to take a sabbatical leave for a few months and explore something different. I decided to go to the National Technical University in Athens, Greece, where my family and I could also spend some time close to relatives, and look into the subject of e-commerce.

While away, I did not shed all of my managerial responsibilities. There were a couple of projects I was particularly interested in and I suggested to the department director to continue managing these projects in a form of telecommuting via the Internet from 5,000 miles away, which he accepted. In addition, I wanted to find out how far I could go with the current state of e-commerce. The question that I wanted to answer was whether it would be possible to do via the Internet from far away all the mundane but necessary things that everyday life in a civilized world imposes upon us, such as manage bank accounts, keep track of credit cards, pay house bills, etc. My goal was to take care of all company and family business back in the US via the Internet, as if I was still physically there.

Armed with an IBM Thinkpad 760E laptop computer and with a lot of hope and excitement about the trip and the experiment, and admittedly with some fear in my heart that I might be betrayed by my overdependence on the use of high technology, I set out on this journey of exploration of the cyberspace capabilities, accompanied by my wife and baby child.

2. Preparations Before the Trip

My first concern was to make sure that I had the software needed to communicate over the Internet properly setup before the trip. My Windows 95 computer was loaded with some key software packages:

- Lotus Notes for sending and receiving e-mail, and accessing project and other internal company databases.
- Intuit's Quicken 98 for keeping track of finances, doing online banking, paying bills, making fund transfers between accounts, and keeping track of my stock portfolio.
- Netscape Communicator, for general Internet access.

These three packages contain 128-bit RSA encryption and are not allowed for export outside the US and Canada. However, government regulations allow American citizens to legally take them abroad and use them for one year, once they are installed in their personal computer.

My second concern was to ensure that I was setup for electronically accessing my various financial accounts so that I could monitor each account's activity. In the absence of the Internet, an old fashioned way would have been to change my mailing address and receive statements via regular mail -in this case surface mail- which usually takes one to two months to arrive, an unacceptably long period. In addition, it did not make much sense to do this for only a five-month period, and then have to change addresses again. Another old-fashioned way would have been to have an entrusted friend receive my mail, sort it out, and then send it to me via airmail. Again, that would have been an error prone and more expensive process with longer delays than direct access via the Internet and, more importantly, a burden on my good friend. So, I requested that my mail be forwarded to a P.O. Box I rent at my neighborhood Post Office, and did the following:

- My salary was electronically deposited into my bank account and corresponding statements were sent to me via e-mail on Lotus Notes.
- I had already made arrangements with Chase Bank for online banking via the Quicken software. This process took place over a period of a few months and required the set up of accounts, installing the software, and debugging the process. It involved making phone calls to Chase customer service and receiving passwords over the mail. Once I got everything to work properly, making a money transfer or writing a check over the Internet became trivially simple.
- I made arrangements by calling the Chase customer service so that I could download my Visa credit card transactions via Quicken. Transactions were usually available for downloading two to three days after they were sent to the Visa clearing house by the merchant, thus giving me a timely update of the use of the card and remaining balance.
- I also made arrangements with AT&T Universal Card to download my MasterCard statement over the Internet. This was a different process than the Chase setup. The Internet access setup was done directly from the web site *www.att.com/ucs*. I entered my card number and chose a user id. A few days later, a password arrived via the US mail to my home address. This setup allowed the downloading of the account statement, which was posted once a month.

Of the other preparations for the trip, an interesting experience was my efforts to sell the older of our two cars, a Toyota Celica, via the Internet. I just happened to hear in a TV news show that *www.autoweb.com* was becoming very popular with the public for trading used cars, so I decided to place an ad myself. It was a very easy thing to do. I visited the site, supplied the car information along with the desired selling price, my name and phone number, e-mail address, and an access code to use when I wanted to make changes to the ad, and submitted the request. For payment ($19.95) I entered my credit card information. A few minutes later I received an e-mail message confirming the submission of the ad and the ad number.

The ad was active for a month. During the first two weeks, I did not receive any phone calls, so I visited the web site, entered the ad number and password and changed the selling price to a lower one. This time I received a couple of e-mail messages and a few phone calls, one of which was from a fellow in Endicott, New York, a good four-hour drive away. He seemed very interested in the car but wanted a picture of it to show it to his wife before driving all this distance to take a look at it in person. I promised I would send him one via e-mail.

I did not have a digital camera but I used, instead, my videocamera and Snappy, a video snapshot device, and generated a picture in JPEG format which I sent via e-mail from Netscape Communicator as an attachment file. My prospective customer received the e-mail but could not see the picture. I thought something must have gone wrong with the transmission, so I e-mailed it for a second time, again with the same results. I even converted the picture into an ASCII file using the UNIX program *uuencode* and sent it as a regular data file but that didn't help either. I was getting frustrated that I was going to lose my customer because of an unexplained problem in this complex communications software when, the following day, he called to tell me that the problem was solved. The culprit turned out to be a missing driver in his Windows-95 system. A friend of his discovered the problem and promptly solved it by installing the driver. After that, he was able to receive the picture and, most importantly, he told me that he was still interested in the car. But the next day, he called to say that his wife did not like the car and that they were going to pursue other alternatives.

Time was running out, so we decided not to sell the car and leave it in the garage. Since we were not going to use it for a while we thought that we could save some money by discontinuing the insurance coverage. A visit at the New York State's Department of Motor Vehicles (DMV) web page *www.nydmv.state.ny.us*, gave us good instructions on what to do. We could temporarily discontinue the insurance coverage but had to return the license plates to the DMV, which we promptly did.

Other preparations that were done via the Internet included:

- I needed to have my passport renewed. I found all the needed information along with application form at *www.state.gov*
- I made reservations for a car in Athens using *www.hertz.com*. This service was available for #1 Club members. After visiting the site, I only needed to enter my account number and details about the date, place, and type of rental car.

3. Living and Working 5,000 Miles From Home Base

Once we arrived in Athens, connecting to the Internet was very simple. First, I obtained a small cable adapter for the 220V power wall socket, which is a different type in Greece than in the US. The AC power adapter of the laptop automatically detected the voltage of the power source (i.e., 220V vs. the 110V used in the US) so I did not have to use an additional transformer. Then, I used the local dial-up number for IBM's Global Network (IGN) and connected to the Internet at 28.8 Kbaud without any problem. I also had Internet access from a workstation in my office at the University, which was LAN connected (via Ethernet) to the University's backbone network.

Greece has significant networking infrastructure that provides international connectivity. There is the academic network GRNet, funded jointly by the European Union (EU) and the Greek government, that connects universities, technological institutes, and government research centers. The backbone network connecting three major Greek cities (Athens, Thessaloniki, Iraklion) operates at 34 Mb/s. International connectivity is provided via a 10 Mb/s leased line (recently upgraded to 34 Mb/s). In the private sector, there are at least 7 Internet service providers (ISPs), one of which is IGN, and competition is fierce. As a result, monthly access fees are kept low (between US $15-$20).

The number of the Internet users in Greece has been quite small, despite the excellent networking infrastructure. As of spring 1998, the total number of the Internet users was estimated at 70,000, of which around 30,000 had accounts with commercial ISPs and the rest were at academic institutions [Maglaris 1998]. Thus, less than 1% of the

Greek population has had Internet access. This number is significantly below the European Union average (7% of the population) [CommerceNet 1997]. The currently low levels of the Internet use in Greece are not due exclusively to lack of personal computers (estimates as of 2 years ago place the number of PCs in Greece at about 500,000 or 5% of the population [ETD 1998]) but, instead, appear to be the result of educational and cultural reasons, as discussed in detail in [Georgiou 1998]. The current state of e-commerce in Greece is not any different from the low levels of the Internet use. The concepts of e-commerce are relatively well known to the academic community primarily because of EU funded initiatives, such as research projects, workshops, and presentations, but currently there are few local businesses with web sites supporting e-commerce. However, because of the global nature of the Internet, one can easily engage in e-commerce activities across international borders.

During my stay in Athens I was in constant contact with the office via my Thinkpad and IGN. I used the replicate mode in Lotus Notes that allowed me to download my mail, disconnect from the network, prepare responses, and then reconnect to the network to upload them for delivery. While connected to the network, I would also access accounting and purchase order approval software on mainframe computers in the US. Thus, I was able to do all the usual managerial things that project management entails, such as:

- Communicate via e-mail with the people reporting to me and with my own manager to direct project activities.
- Approve travel expense accounts and purchase orders.
- Give salary raises via e-mail. This is customarily done in person but under the circumstances I had to do it with the exchange of messages. I was glad to find out that it was equally appreciated.
- Work with the accounting department to determine budgets.
- Use the Internet to find information so that I could respond to technical questions.

Carrying out these activities electronically seemed like a natural thing to do because I used to do most of them in the same way at Yorktown Heights. What was missing at times, however, was a face-to-face discussion. A solution, here, would have been the use of videoconferencing but that would have required a high-speed network connection (e.g., ISDN line), as well as hardware (video camera, high-speed modem) and software installed both in my Thinkpad and at my colleagues' workstations. While this was possible to do, the complexity and expense of such an approach (considering that we were on different continents) quickly put any further thoughts to rest.

The communications with my home base seemed to be going on quite smoothly, except for a few minor problems:

- A digital certificate used for security purposes in my Lotus Notes account expired and I did not know where to send the request for recertification.
- While changing my password for accessing a mainframe system I lost the network connection and then I was not sure of which password to use. After a few unsuccessful tries the system locked me out and I had to contact the system administrator to be readmitted.

In both cases an e-mail message to the department secretary requesting her assistance provided a quick solution to the problem.

On the personal communications front, things did not go as smoothly. The bulk of my electronic activities took place via Quicken and my online banking accounts. I would regularly check to see the account activity and make necessary payments. Transferring funds between accounts was just as easy. It was a great thing, I thought, to be able to take care of all my financial matters in New York from so far away, as if I was there in person. Two transactions that would not have been possible just a few months earlier were the following:

- I would visit the web site of Con Edison, *www.coned.com*, the utilities company in the New York area, enter my account number and see the electric bill due. Then I would send in a payment order via Quicken and my bank checking account.
- I would visit the web site of my auto insurance company, *www.geico.com*, enter the policy number, find the new car insurance premium and likewise make a payment.

One problem that came up was that all of a sudden I stopped receiving credit card activity from Chase. I sent an e-mail message to the online banking customer service who began looking into the problem. However, after many e-mail message exchanges the problem was not solved. Since I needed to know the balance due in order to send in a payment, the online banking customer service told me that I could get this information by calling the bank's 800 number for credit card transactions.

Calling 800 numbers from outside the US is not straight forward. The 800 service is designed so that call charges are paid by the called party and not the caller. This applies only to phone calls made from within the US or Canada. Furthermore, 800 numbers cannot be directly called from abroad. One has to go via the operator and this is usually a much more expensive phone call than a direct dial. Since most companies in the US provide access to their customer service via 800 numbers, I began exploring other possibilities via the Internet.

I tried using *net2phone*, an Internet phone program from *www.net2phone.com* that provides free 800 calls to the US from anywhere in the world, but I could not get it to work behind the firewall from my IGN connection. I tried the same from my workstation at the University but the connection was coming in with many interruptions that made it practically unusable, despite the high-speed lines connecting the country to the rest of Europe. I was told that the problem was most likely due to the fact that the European academic network connects to the US via a few 45 Mb/s lines, which, as one might expect, can become easily congested, thus introducing delays in the flow of the audio bit-stream.

The due date for the credit card payment was approaching fast and since I did not want to miss it, I was ready to surrender to the old-fashioned ways of operator assisted phone calls. But, quite unexpectedly, I was able to solve the problem on my own. It was a simple but tricky one, similar in nature to the year-2000 problem. It had to do with a change in my credit card account number that was scheduled in the bank's computer many months earlier.

After the merger of Chase bank with Chemical, new credit cards were issued to Chemical's customers but in the computer files the old account number was kept active for some period of time. My Quicken register entry had the old account number and, of course, everything worked fine until the change to the new number took place. Apparently, this change was not known to the support people at the online customer service who believed that I should continue using the old number, something that they had specifically told me to do. But then I remembered a conversation I had with bank personnel when the merger took place, that the old numbers were going to be deleted at some point in time. So, I entered the new account number, the problem was corrected, and I was able to download all the missing information.

Another problem that came up towards the end of my trip was that, all of a sudden, when I tried to log into my AT&T Universal card account at *www.att.com/ucs*, I was not allowed access but, instead, would receive the message: "*We've had a problem processing your request. You must first register, then activate an existing account before using this feature.*" This was a total mystery to me because everything had worked fine for many months. Re-registering was out of the question, as I would have to receive the password via the US mail at my home address. So, I decided to investigate this problem upon my return to the US.

It turned out that the problem was caused by the Post Office. When I forwarded my mail to the P.O. Box I was told that they would keep it there until I returned. But the P.O. Box overflowed and, after a month, they began returning the mail to the sender. When the credit card company saw that their was a problem with my mailing address, they froze the online access to my account (but not the account itself).

On the positive side, a problem that I always feared could happen but fortunately never did was caatastrophic equipment failure (e.g., hard disk drive failure) or theft. Before leaving for the trip I made backups of all key Lotus Notes and Quicken files. But if any of the above happened, I would have had to find a way to replace the hardware, reinstall all the software and bring my system up to the most recently used state. I considered a tape backup, but that would have added up weight to the equipment I was carrying. Also using a backup tape to recreate from scratch an old system on a new computer seldom works 100% because of the different configuration files of the two systems. In other words, that would have been a nightmare that I was lucky enough to have avoided.

4. Lessons Learned

In the beginning of September my sabbatical leave was over and it was time to take the return flight back to New York. The experiment that I wanted to run when I set out on this trip to Greece was to see whether it was possible to take care of all company and family business back in the US via the Internet, as if I was still physically there. Without any question, I feel that the experiment turned out to be quite successful.

The experience that I had has shown that e-commerce has now gone beyond the stage of discussion and is being broadly implemented. Within the past year, a large number of companies in the US have become e-commerce enabled. Furthermore, a lot of networking infrastructure exists worldwide which makes the concept of international telecommuting a reality. Improvements in two areas of Internet communications, such as videoconferencing to the laptop (or desktop) and more useable Internet phone service could result in better person-to-person interactions when exchanges between humans are needed. Both would be greatly helped by higher bandwidth and better quality of service in Internet networks.

Two of the potentially biggest obstacles to the broad acceptance of e-commerce by the general public (and not only those technologically inclined) were highlighted by problems I had, i.e., one with the Internet delivery of the car photo and the other with the downloading of the credit card transactions. These are:

Complexity of current personal computer software and hardware. This is a problem that has been widely discussed and attempts are being made to solve it by various approaches (for example, development of Java-based network computers, and others). The device that carries out e-commerce transactions must have the same ease of use that the telephone or the television set currently have. In either case, the device has a simple user interface and it always works, for all practical purposes, without any delay. Of course, these technologies have been refined over a much longer period of time than the personal computer and Internet technologies. It is not, therefore, accidental, that they have reached a level of usability that has made them ubiquitous.

Poor end-to-end diagnostics and lack of feedback for problem determination. Carrying out an e-commerce transaction is a very complex operation that involves multiple computer systems, communications networks, and large application programs. When everything works fine, a transaction can be successfully completed. If, on the other hand, something goes wrong, it is very difficult to find out where the problem lies. For example, in the case of the credit card account change, the system could have come back with at least an error response of the type "Incorrect credit card account number received at the bank." Instead, there was no error indication whatsoever; only missing transaction data. This made any attempts at problem determination very difficult. What is needed is to have sophisticated diagnostics software at every stage of the transaction path. An expert system can then process the information extracted and present it to the end-user in an easily comprehensible way.

5. Summary

This paper presented an experiment in international telecommuting, in which all work-related and household matters in the US were taken care by the author via the Internet while living in Europe. This was made possible by the rapid adoption of e-commerce by a large number of companies in the US and the Internet infrastructure that is available around the world. While the current state of e-commerce allowed this experiment to be quite successful, improvements are needed if we expect to see large numbers of consumers confidently attempt to depend so heavily on the use of these new technologies.

References

1. Fall 1997 CommerceNet/Nielsen Internet Demographic Survey, *www.commerce.net/research/stats*
2. Maglaris, B. (1998), "Academic/Research Computer Networks in Greece - The European Dimension," presentation to the *Telecommunications Forum*, Athens, Greece.
3. European Telework Development (ETD) (1998), "Statistics Relating to Information Technologies in all EU countries," *www.eto.org.uk/eustats/*
4. Georgiou, C.J., & Stefaneas, P.S. (1998), "Strategies for Accelerating the Adoption of E-commerce by Consumers Worldwide," *IBM Research Report RC 21277.*

Web-Based Distance Education in Hawai'i

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Abstract: The University of Hawaii at Hilo, on the Big Island, offers a B.S. in computer science to students on other islands in the state where a four-year institution is not available. This paper described the planning for this program and the first year experience in its delivery. Care was taken to use the Web to support course delivery in ways that exploit unique capabilities the web offers that are not so easily duplicated on the ordinary printed page. Outcomes, both objective and subjective, are discussed.

Introduction

The state University system of Hawaii includes a research-level campus on the island of Oahu near the state capital of Honolulu, the regional comprehensive University of Hawaii at Hilo campus on the Big Island of Hawaii, a two-year upper-division campus at West Oahu, and seven community colleges scattered throughout the state. The islands of Maui and Kauai are served by community colleges but no four-year institutions, and the rapidly growing West Hawaii area is 100 miles away from Hilo.

Within the past two years, community colleges at Maui and Kauai and West Hawaii have been empowered as University Centers. This gives them the authority to broker selected four-year degree programs or even graduate degree programs for which there is a demonstrated need. The University Centers may "contract" with any institution of higher education to deliver these programs.

The University Center at Maui has contracted with the University of Hawaii at Hilo to deliver a B.S. degree in computer science using a variety of educational technologies, including the World Wide Web. This paper discusses the planning and preparations leading up to this agreement, the experiences delivering the first year of the degree program, and the educational issues involved.

Planning

Once an initial "market interest" had been established for an undergraduate computer science degree, a long period of negotiation ensued to iron out many of the administrative details such as scheduling, delivery mechanisms, counseling, faculty workload, on-site responsibilities, etc. This was the first such program brokered through the University Center and was breaking new ground, so each of these questions, while seemingly routine, had to be addressed.

The following list indicates how these sorts of questions were ultimately resolved.

- Students apply to the B.S. in computer science degree program at UH-Hilo; if accepted, they become UH-Hilo students and pay UH-Hilo tuition.

- Students without a previous degree must complete the equivalent of an AA degree at the local community college. This satisfies the general education requirements for the degree (English, speech, humanities, and social sciences.)
- Students take the special supporting courses required for the degree at the community college (one semester of technical writing, one year of calculus, one year of physics, one year of chemistry). Calculus is prerequisite to admission, but the sciences may be taken later.
- Students complete the first year of computer science at the community college.
- UH-Hilo is responsible for delivering the computer science courses for years 2, 3, and 4, plus the three upper-division mathematics courses required for the degree.
- All courses are designed to duplicate, as much as possible, the on-campus educational experience as far as the content covered, the software and computing platforms used, what is required of the students, and the activities in which they engage.
- All courses are offered on an evening or weekend schedule to accommodate working students.
- Courses are part of the regular faculty workload, that is, a distance ed section counts for one course the faculty member teaches, just as an on-campus section does.
- Courses are scheduled as much as possible so that a faculty member teaching a distance ed section has an on-campus section of the same course at the same time.
- Courses are scheduled so that a student can complete the degree program in four years, including summers.
- The University Center staff is responsible for marketing the program, screening potential applicants, and providing on-site general counseling.
- The University Center/community college is responsible for providing, within reason, necessary computing laboratories and software to support the courses.
- The University Center/community college staff is responsible for handling any physical mailings between the two campus locations, i.e., collecting or distributing hard copy of any materials, exams, etc., as well as for monitoring on-site exams.
- The community college staff is responsible for on-site TV transmission.
- UH-Hilo is responsible for TV transmission in support of instruction.
- UH-Hilo is responsible for handling registration, maintaining student records, and providing academic counseling.
- A grant from Maui County, through the University Center, provided funding for faculty release time in preparation for teaching in a distance education mode and a multimedia center to produce web-based materials.

Table 1 shows the four-year course rotation agreed upon.

	Fall	Spring	Summer
Year 1	Discrete Math	Data Structures	Linear Algebra
Year 2	Computer Organization, File Management	Computer Networks, Database Design	Probability & Statistics
Year 3	Software Engr. I, Formal Lang. & Automata Theory	Software Engr. II, Programming Languages, Professionalism	Numerical Analysis
Year 4	Operating Systems, CS Elective	Computer Architecture, CS Elective	

Table 1: Course Rotation

The First Year

The first cohort of students was admitted in Fall, 1998. The majority of the students (19) were on Maui, and a small group (3) were on Oahu. During the academic year 1998-99, Discrete Mathematics and Data Structures were taught to these students via distance education from UH-Hilo.

A combination of interactive television and on-line, web-based instruction was used as the vehicle for delivering these courses. In addition, the instructor made several visits to the two distance ed locations to meet with students. The interactive television component used HITS, the Hawai'i Interactive Television System, for a class session every Monday evening from 7-9:45 PM. The web-based component used WebCT, a password-protected web-based teaching environment developed at the University of British Columbia. The instructor's original inclination to use entirely web-based instruction was discarded based on experience as an auditor in a 100% web-based course; it is too easy for students to fall into an "out-of-sight, out-of-mind" mindset when there are no regular checkpoints. Attendance at the HITS sessions was not required, but the students seldom missed this opportunity for face-to-face interaction. The TV sessions are recorded, and the tapes are also available for students to review later.

A brief description of each of these two courses will help clarify choices made in the use of these two technologies.

The discrete mathematics course is, indeed, a mathematics course, although laced with applications for computer science. The course is heavily based on problem solving, with students working in collaborative groups to develop and present problem solutions, and to critique the solutions of other groups. The advantage to this being the first course taught in this distance education degree program was that it is not a programming course, so the issues of hardware platforms, programming language, and software availability were postponed. However, there were disadvantages. First, this is one of our most difficult courses, and to hit these students right out of the box, so to speak, with both a very difficult course and an introduction to distance education all at once was a bit harsh. Second, as a mathematics course, there were problems with notation. While we all coped with questions and answers on text-based e-mail by inventing shorthand for various mathematical notation, I required Word documents to be submitted for homework, where the Symbol font covered most of what we needed to use.

The data structures course covers algorithms for searching, sorting, hashing, data compression, and graph algorithms, with a heavy emphasis on analysis of the efficiency of various algorithms. Work in the course is heavily programming-based. Assignments require experiments to measure algorithm behavior on test sets of data and reports on the results as compared with those predicted by the theoretical analyses we develop in class. This introduced issues of programming language and compiler availability. While students had completed one year of programming at the community college, their language was Java, while this course was taught in C++. The instructor had been contemplating teaching the course in Java, but one of the students, pressing this point, argued "We've already had a year of Java, if we work for four more years we'll really get to be expert in that one language and stand a better chance of competing in the job market." This had precisely the opposite effect from what the student intended, as we believe our degree program is designed to, among other things, give the students the intellectual tools to cope with any programming language that comes down the pike. Hence, the course was taught in C++, with a heavy language review at the beginning of the semester.

The HITS system has been used for distance education in the state for some years. The instructor assumed that this would be a tried-and-true technology with little cause for concern, whereas WebCT, a new technology, might be the more problematic medium. The opposite turned out to be true. HITS had previously been used for delivering lecture-based courses from site A to site B, with possibly one or two student questions at the end. In the mode we were using HITS, the instructor was at site A, students were at sites B and C, and the classroom sessions, particularly in the discrete math course, consisted primarily of problem presentations and solution discussions. A student on Maui presented a solution, a student on Oahu had a question or an alternate solution, the instructor had a comment, etc. Transmission was emanating from three sites, and all transmissions went to a fourth "master control" site on Oahu that was responsible for controlling which transmission all sites were receiving. Because of the interactive nature of the class, the master control site had to constantly monitor the transmission and make the necessary signal switching go quickly and smoothly. The quality of this service varied greatly, depending on the individual at master control. Indeed, one of the frustrations of the HITS component was that the instructor had to rely on the capabilities of so many technical people (at four different sites) and the fact that down-time in any of the equipment (or individuals) left the synchronous classroom session at risk.

WebCT proved to be a reliable and extremely useful environment for on-line course support. It provides a number of features, including bulletin board discussion groups, private e-mail, a testing capability (not used for these courses), a grade management system, the ability to post HTML content pages, a chat room, and an electronic whiteboard. (There is also an on-line HTML editing capability in WebCT, but it is a rather cramped environment in which to work. It is much more satisfactory to develop the web pages elsewhere and then port them to WebCT.) These capabilities are wrapped in an easy-to-use shell wherein the instructor can upload files, arrange icons with links to content pages, set up forums for discussion within the bulletin board, attach files to e-mail or bulletin board postings, etc.

For both courses, the bulletin board and e-mail in WebCT (as well as "traditional" e-mail) provided a vital communications link between students and instructor. Particularly in the discrete math course, where the students worked in collaborative groups, the bulletin board - with a private forum for each group - was the basis for their collaboration. In both classes, the bulletin board provided a location for updates, questions and answers, and "are we meeting for a study session Saturday" postings. The chat room, which was regularly scheduled with the instructor for two hours every Thursday evening, also allowed some extremely lively and useful technical discussions. These communications served the place of the more frequent classroom meetings and the conversations in the instructor's office of the on-campus versions of the courses. Support for asynchronous communications among students, and between students and instructor, seems to be one of the most important components of any on-line distance education course. If this were the only part "the web" played in these two courses, it would still have been crucial.

Communication is pointless, however, without course content. Each class used a traditional textbook, which students were expected to read. For the on-line course content pages, then, there was no point in merely repeating sections of the text. The course content pages were primarily used for two purposes. One was to give the "value added" viewpoint that the instructor presumes to present over and above that which is in the textbook. As in a classroom setting, the instructor does not merely regurgitate the text to the students, but provides a larger context, relates new topics to what has gone before (or to other courses), fills in troublesome details omitted from the text, or gives alternative examples or explanations. However, this information, although it was posted as web pages, could have been delivered to students as a hard-copy handout, which would probably have been easier to read. The second use of the course content pages was intended to exploit capabilities the web offers that are not so easily duplicated on the ordinary printed page.

In the discrete math course, the course content pages consisted primarily of typical problem solutions. For each type of problem that the students were expected to learn how to solve, a typical problem statement was given (a different problem from any in their text). Succeeding pages developed the solution, much as the student would be expected to write it. As the student navigates the pages, the solution unfolds step-by-step. However, a compressed audio file was also part of each web page after the initial problem statement. The audio file contained a first-person stream-of-consciousness thought process about that step of the solution - why it occurred to the narrator to try this, why it looked promising, what knowledge was being called upon to suggest that this should come next, etc. The point is, students see perfect and complete worked-out proofs in the textbook, and often see them performed by the instructor. Yet when a student goes home and tries to produce such a solution by himself or herself, he or she is unsure where to start or how to think about the problem or how to see any pattern to enable a guess as to what to do next. Consequently the student gives up in frustration. The purpose of the audio narration is to share the "secret picture" that mathematicians use to solve problems. Several of the audio files even start the narrator down a dead end, recognize the dead end, and back up to start again. In a poll at the end of the semester, students rated these content pages the most helpful feature of the web site.

In the data structures course, students have to understand how various algorithms work. Simple gif animations that students access by links from the content pages illustrate algorithms at work on small data sets. This visualization capability is very important in talking about algorithms, and the gif animations are the natural successor to the sequenced overhead transparencies or PowerPoint slides of previous years. The animations are also features that the students love. Static graphics were also incorporated into web pages via electronic pen software that works on a graphics tablet.

Lessons Learned

Academic Outcomes

The distance education discrete math and data structures courses both had tests, homework, and programming assignments identical to what was given in the on-campus sections. As a "control group," the on-campus discrete math course in the first semester had no access to the web-based course materials. The outcomes as far as the overall average grade is concerned were virtually the same. Table 2 shows the first semester grades. The on-campus class had greater variation in arriving at the final average, scoring higher on the homework but lower on the tests than the distance ed group.

Grade	On-Campus	Distance Ed
A	2	4
A-	0	1
B	4	3
B-	1	5
C	10	5
D	4	2
F	0	2
Semester Average	76	77

Table 2: Comparison of Grades

It is certainly possible, then, for a distance ed course to achieve levels of student performance comparable to those of a traditional class. If the grades in a course are indeed indicative of student learning, then we may say that the students in the distance ed program are "learning as much" as the on-campus group. But there are other, more subjective evaluations to the success of a course.

Student Opinions

The distance ed students were initially overwhelmed both by the course material and its level of difficulty, and by the fact that no instructor was physically present on their campus. As a result, the students engaged in a "negotiating mentality" for much of the first semester: Won't you do this for us, won't you do that for us, won't you give us extra credit work, won't you drop our lowest grade, won't you come over and visit every weekend, won't you increase the chat line with us to 4 hours per week instead of 2, ... Once the students gained more confidence with this learning mode and realized that the instructor was going to hold the line at a reasonable level of accommodation, a better working mode developed.

A survey administered at the end of the discrete structures course asked both on-campus students and distance ed students to give information on their academic background (do they already have another degree, for example), the number of hours they worked, the number of hours they studied, their expectations of the course beforehand, and their evaluation of the course afterwards. As expected, the distance ed students generally worked more hours and were taking fewer classes. Surprisingly, they also spent more hours per week studying for this class. They had less idea beforehand what to expect of the course (not being privy to campus gossip), but seemed equally satisfied with the course once it was over. Some expressed the opinion that a face-to-face course would have been preferable but they recognized that such a course was not available, and found this an acceptable alternative. Students expressed particular appreciation for the audio file pages in the course content on WebCT.

Instructor Opinion

The instructor shared the student view that a face-to-face class would be preferable. After all, college faculty teach because they love to teach, and personal interaction - particularly the ability to see the "Aha" moment in a student's eyes - is a large part of that. An "OK, I see it now" on the chat line or over a bulletin board doesn't carry quite the same thrill. However, these alternative forms of interaction lend themselves to an informality that may not exist in a classroom setting. And, again, when there is no alternative, a distance ed class comes to the rescue.

The challenge is to learn how to create educational experiences and materials to really make use of the new capabilities of the web. This seems particularly difficult in a technical course where the course content is more sequential in nature and it's not appropriate to assign students some research paper where they run off and search the web for lots of material or engage in on-line debate about points of view.

The instructor had been to a number of workshops and presentations on distance education, where all the presenters said the same things: it takes lots of time to develop course materials, you must have help in putting things together, you will spend a lot of time interacting with students via e-mail and bulletin boards, etc. Even forewarned, it was still astonishing the amount of time required to prepare for and manage these courses. An estimate of instructor time on various kinds of activities for the first semester appears in Table 3.

Activity	Time Estimate hours/week
Actual student contact hours (HITS plus chat room)	5
Answering e-mail questions, monitoring bulletin board	10
File management	5
Grading	12
Slide preparation	6
Course content pages	15
Total	53

Table 3: Distribution of Instructor Time

In addition, a student helper spent about 6 hours per week recording the audio files from the instructor's scripts and posting the results to the WebCT site.

This is a serious investment of instructor time, which may be amortized over future offerings of the course. The last two items in Table 3 should require much less time commitment as they will be revisions rather than original work.

Conclusion

The distance education B.S. in computer science offered by the University of Hawaii at Hilo seems to be off to a good start. It is clear that if both the instructor and the students are willing to make the effort, these students can succeed at the same rate as an on-campus class. It is gratifying to think that we are providing them with an opportunity for higher education they would otherwise not have at all. We hope to attract a second cohort of students for fall 2000 to start another rotation of courses.

Hawai'i was, after all, the originating site for one of the earliest network communication protocols (the ALOHA protocol for packet radio transmission between islands developed at the University of Hawaii in 1971). It seems only fitting that education via the web and other technologies should carry on this tradition.

Arthur: Adapting Instruction to Accommodate Learning Style

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Abstract: The theory of learning styles states that people have different approaches to learning and studying (Dunn 1987 & Dunn 1978). Given a specific instruction method or environment, some people will learn more effectively than others due to their individual learning style and the grade distribution of the learning would be bell shaped, with the majority of the learners appearing in the middle of the distribution curve. Several studies show that there is "No Significant Difference" when technology is applied to instruction (Russell 1999), since either in traditional classrooms or in any of the technological environments, there is only one form of instruction, and usually from one source, yielding the familiar bell shaped grade distribution. This explains the "No Significant Difference" results and indicates that another instruction method needs to be investigated. An approach to achieve "A Significant Difference" is to provide several different instruction methods. This paper describes Arthur, which is a Web-based instruction system that provides adaptive instruction to achieve "A Significant Difference".

Introduction

Learning styles are approaches to learning and studying (Dunn 1987). We all have learning preferences, which enable us to learn more effectively. When introduced into a learning environment that supports our learning style(s), learners have a higher level of understanding the material. The learning styles theory implies that how much individuals learn has more to do with whether the educational experience is geared toward their particular style of learning. In a traditional classroom environment, there is one instructor and several learners, which is an one-to-many relationship. The instructor presents information with his/her personal style of instruction. The instructor may use technology such as overhead slides, computer animations, videos, or simply chalk and talk lectures. If the instructor's style of instruction is conducive with the majority of the learner's learning style, then the class as a whole will perform well. In the general case, the instructor's style is conducive with most of the learner's, but not a perfect match. In this case, the majority of the class will have an average performance with fewer people doing either very well or very bad, which establishes a bell shaped grade distribution.

There are several different learning styles and combinations of styles. Sarasin (1998) discusses auditory, visual, and tactile learning styles. Inquiry-Based Learning (Pasch 1991), Discovery Learning (Bruner 1966), and Expository Teaching (Ausubel 1977) are just a few other learning styles. There are several other learning styles and instruction methods. In fact, learning styles or instruction methods can overlap or be used in combination with other methods. When considering all the possibilities of instruction, it becomes clear why there is a bell shaped grade distribution in the traditional classroom. It becomes an impossible task to accommodate everyone's learning style. Therefore, instructors generally use what works best for them and on the average, most people get it, yielding a bell shaped grade distribution.

In the tutoring environment there is one instructor and one learner, which is an one-to-one relationship. This environment would appear to be an improvement on the traditional classroom because of the personalized attention. This may be so, but there is still the limitation of the tutor's ability to adapt to the learner's learning style. If the tutor can not adapt to the learner's learning style, then the learner does not gain very much of an advantage over the traditional classroom.

Imagine a classroom full of instructors and only one learner, which is a many-to-one relationship. Each instructor is an expert in the same field of study, but each uses a different style of instruction. Hence, the learner's chances of doing well in this classroom would appear to be significantly better than in a classroom with one instructor because each learner would adapt to the instructor(s) that would facilitate his/her learning style. In the sections that follow, we will introduce an implementation of the many-to-one relationship.

Arthur: Adapting Instruction to Accommodate Learning Style

We have developed a Web-based instruction system that provides adaptive instruction, Arthur (Gilbert 1999). Arthur takes several different styles of instruction from several different instructors and makes them available to each learner, which defines a many-to-one relationship. A group of instructors from the same field collaborate to create a course map, which is similar to a syllabus, for the course content. The course map is divided into small sections that are called concepts. A concept is a basic unit of instruction or a fundamental concept that must be covered within the course. In Figure 1, there are 3 instructors. Each instructor has their own course module, which is identified as a row. Each module utilizes a different form of instruction. For example, instructor Gilbert's module utilizes an audio based method of instruction. Notice that each instructor's module adheres to the same concept map, where concepts are represented as columns. Each module begins with concept 1 and ends with concept 4. Each cell in Figure 1 represents a concept which utilizes a different form of instruction. This information is added to Arthur via Web-based forms.

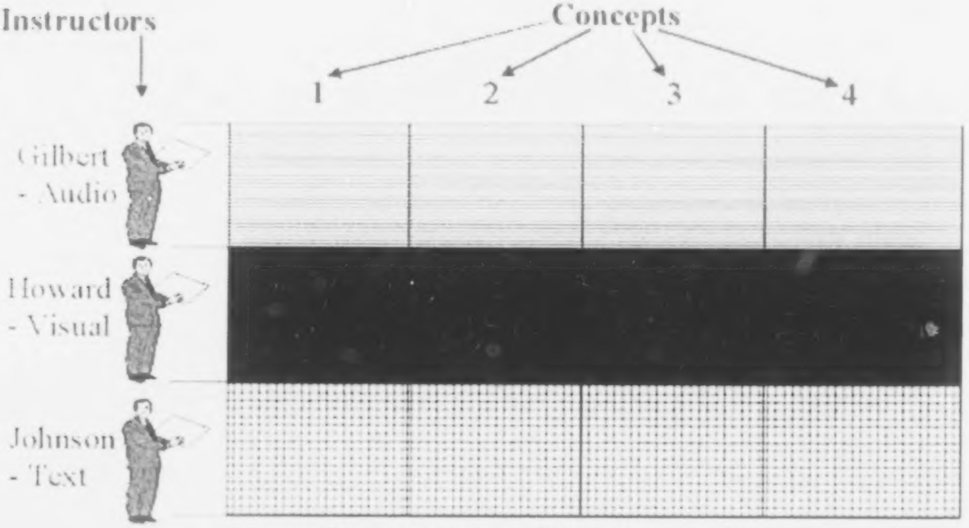

Figure 1: Concepts and Modules

Submitting Content

Instructors will add their course module to Arthur via several Web-based forms. Each instructor will deposit URLs that point to the first page associated with each concept within their module. Arthur will reference concepts via URLs submitted by the instructor. This will allow each instructor to maintain his/her own course materials on their own Web servers. Instructors will also add their personal information into Arthur as well. This includes their name, affiliation(s), email address, etc. Finally, the instructors will submit quiz questions that will appear at the end of each concept. The quiz questions appear in the form of multiple choice or written answer. Once instructors have submitted their course materials and quiz questions to Arthur, the system is ready for learner use.

Learning Experience

When a learner enters Arthur using a login and password, Arthur will deliver the first concept of one of the course modules from the instruction pool. The courses are initially selected at random. Therefore, each student will be assigned their first course module by chance. Each concept is terminated by a short evaluation quiz entered by the instructor. For example, John Smith logs into Arthur. John is assigned the first concept for Calculus 101 using an Auditory (Sarasin 1998) Expository Teaching (Ausubel 1977) style, which was developed by instructor Carl Gilbert. This style uses audio to present a general explanation of each concept followed by examples. When John completes the first concept, he will be given a short quiz. The quiz is delivered through the Web using Arthur. The quiz will be graded by the instructor, Carl Gilbert, or automatically by Arthur, i.e., multiple choice. Instructor Gilbert will be notified via email that a quiz has been taken. After notification, instructor Gilbert will log into Arthur where the quiz questions and answers will be presented. The learner's name, John Smith, is never revealed to instructor Gilbert only the question and answers. After grading the quiz, instructor Gilbert will report a score for the learner. The student must pass each section with a score of eighty percent or better in order to continue within the current course module. This evaluation method introduces the term *Mastery Learning*, which is used by Arthur to adapt the instruction style.

Adapting Instruction

Mastery Learning is based on the assumption that, given enough time and proper instruction, most students can master any learning objective (Bloom 1968 & Guskey 1986). The normal distribution of scores learners exhibit on any performance test arise from the use of one instruction style given by one instructor and the practice of holding instructional time constant for all students and allowing learning to vary. Bloom (1976) suggest that learning should be held constant and time allowed to vary. To use the mastery approach, an instructor must break a course down into small units of study, which correspond to concepts within Arthur. Each unit might involve mastering several specific concepts or objectives. Mastery usually means a score of 80 to 100 percent on a test or other assessment (Woolfolk 1998).

Arthur uses mastery learning to adapt instruction for each learner. When a learner completes a quiz at the end of a concept, Arthur employs mastery learning to adapt the instruction based upon the learner's score for each quiz. If the learner scores 80 percent or better, Arthur will allow the learner to move onto the next concept using the current course module. In the Calculus 101 example, assume John Smith passes the first concept of Carl Gilbert's course module with a score of 90 percent. Arthur will present John Smith with the second concept of instructor Gilbert's course module. John Smith scores a 70 percent on the quiz following the second concept. Arthur presents John Smith with the second concept of Frank Howard's Calculus 101 course module, which uses a different instruction style from Carl Gilbert's course module. Therefore, when learners pass the quiz at the end of a section, Arthur assumes that the instruction style used in that section matches the learner's learning style.

Learner Models using Case-Based Reasoning

When a learner successfully completes a course using Arthur, the system creates a learner model, which is a learning map, of the learner's learning experience. The learner model contains each concept that the learner passed and failed. In the cases where the learner failed the quiz at the end of a concept, Arthur records the questions that the learner missed. The missed questions at the end of each quiz are used to classify future learners when adapting instruction. This type of classification is called *Cased-Based Reasoning*. In case-based reasoning new problems are solved by adapting or matching previously observed cases. A new problem is matched against cases in the case base and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused (Reisbeck 1989 & Kolodner 1993).

For example, when John Smith completed Calculus 101, he failed the quiz following the second concept of instructor Carl Gilbert's module. John missed questions 1, 2, 4, 6, 7, 8 and 9, which are used to create a case base for John. Also, note that John was reassigned concept two under Frank Howard's Calculus 101 course module, which John passed with a score of ninety percent. Later, Chris Hudson logs into Arthur to take Calculus 101. He is assigned instructor Gilbert's course module. Chris passes concept one and fails concept two, just like John Smith. When Chris fails concept two, he misses questions 1, 2, 4, 6, 8 and 9, the same questions John Smith missed. Using the knowledge of the John Smith's case base, Arthur will classify Chris as a learner with a similar learning style as John Smith and reassign concept two to Chris using Frank Howard's course module. Because John Smith's case base for concept two is similar to Chris Hudson's new case base, Arthur assumes that Chris Hudson has a similar learning style to that of John Smith and assigns Chris an instruction method based on John Smith's case base. Classifying new learners is not the only purpose of the learner model.

The learner model is also used when previous learners return to Arthur to take a new, yet similar course. For example, if John Smith returns to Arthur to take Calculus 201, then Arthur uses John's learner model to assign John instruction methods. Given our previous examples, Arthur will assign John to instructor Frank Howard's course module because John performed best within this module compared to the other modules. If John does not perform well within instructor Howard's Calculus 201 course module, Arthur will use any previous Calculus 201 case bases to adapt instruction for John as necessary. Otherwise, Arthur will reassign concepts to John at random with an emphasis on instruction styles similar to that of instructor Frank Howard's, since John scored so well under Howard's Calculus 101 module.

The random selection of concepts within Arthur occurs when there are no previously stored case bases available for the current learner. Each course module is placed into a course module category: auditory, visual, tactile or text based. When a learner fails a quiz at the end of a concept, Arthur searches for a matching case base. If there is no matching case base available, Arthur will randomly select a new instruction method from a different course module category. The random selection of an instruction method from a different category will increase the chances that a match will be obtained. In the following sections, we will describe the system implementation of Arthur.

System Implementation

Client Side

Each learner will use Netscape Navigator 4.x or Internet Explorer 4.x to use Arthur. Once the learner goes to the Web site that hosts Arthur, the learner will be forced to authenticate using his/her pre-assigned login and password. The interface to Arthur uses a Java applet in a HTML frame to provide all the navigation information from the Web server. Special client side software requirements may be necessary for particular courses upon the demand of the instructor. For example, an instructor may require that the learner have a particular programming language installed on their computer in order to compile and test programs. Another instructor may require that the learner's computer have a particular database package or word processor. These requirements depend on the individual instructors and the tools needed to successfully complete their course.

Server Side

Arthur uses a complex knowledge base (Russel 1995) to store information and relationships on the learner, instructor, courses and the learner-instructor interactions. The knowledge base is stored in a SQL (Elmasri 1994) database on the Web server. The knowledge base consists of database tables that contain facts gathered by Arthur from the learner and instructor. It behaves as a repository of facts that can later be used during decision making, i.e. adapting instruction. The Java applet in the learner's Web browser communicates with the knowledge base through a Java socket process. This provides fast and platform independent access to data in the knowledge repository. Arthur handles frequently asked questions using an implementation known as Intelligent FAQ.

Intelligent FAQ

Arthur will also make use of Intelligent FAQ, which is an information retrieval (Salton 1989) system used to answer frequently asked questions. When the learners are going through the course modules, questions will arise about the concept being learned. In order to answer those questions quickly and effectively, Arthur utilize Intelligent FAQ. Intelligent FAQ accepts a question from the learner and creates a query string as seen in information retrieval systems. The query string is created by removing the stop words (Britanica 1998) from the original question. After the stop words have been removed, each query string will be categorized. Arthur categorizes questions by concept and question type. Each question that is asked will be assigned a concept. In other words, the curren' working concept that the learner is actively pursuing will be the concept assigned to the question asked. The question types are what, when, where, why, how, define, who and other. Therefore, the query string is composed of a concept, question type and the question with the stop words removed. When a question appears for the first time, it is sent directly to the instructor via email. The instructor will log into Arthur and answer the question. Once the question has been answered, the learner will receive an email notification that an answer has been submitted. The learner will log into Arthur and pick up the answer to the question. Arthur will store the query string and answer in the knowledge base (Russell 1995) for later use. When a different learner asks a similar question, Arthur will retrieve the answer from the previously asked query string and answer stored in the knowledge base. Intelligent FAQ is being developed as part of Arthur, but can be used on any Web site.

Conclusions

The theory of learning styles states that people have different approaches to learning and studying (Dunn 1987 & Dunn 1978). Several studies show that there is "No Significant Difference" when technology is applied to instruction (Russell 1999). The most commonly used instruction environments use an one-to-many or one-to-one instructor/learner relationship. We have developed an environment that utilizes technology to deliver a many-to-one instructor/learner relationship. Before the recent use of technology, this type of education experience would have been too expensive to implement. Using the world wide Web and supporting technologies, we can deliver a many-to-one instructor/learner relationship such that individual learning styles can be accommodated.

Arthur will be initially tested using Physics 101 and CS 1, computer science programming with C++. It is expected that other domains will work as well. In the future, Arthur will add new domains of instruction. For example, the arts, sciences, languages, mathematics and other engineering disciplines will be added to Arthur. In the short term, Physics 101, which is currently being taught to various degree tracks, and CS 1 will be used to gather initial data results.

References

Ausubel, D. P. (1977). *The facilitation of meaningful verbal learning in the classroom*. Educational Psychologist, 12, 162-178.

Bloom, B. S. (1968) *Learning for mastery*. Evaluation Comment, 1(2). Los Angeles: University of California, Center for the Study of Evaluation of Instructional Programs.

Bloom, B. S. (1976). *Human characteristics and school learning*. New York: McGraw-Hill.

Britannica Online, (1998). *Britannica Searching Stopwords*. [Online]. Available: http://www.eb.co.uk/help/searsto.htm.

Bruner, J. S. (1966) *Toward a theory of instruction.* New York; Norton.

Dunn, K., & Dunn, R. (1978) *Teaching students through their individual learning styles.* reston, VA: National Council of Principles.

Dunn, K., & Dunn, R. (1987) *Dispelling outmoded beliefs about student learning.* Educational Leadership, 44(6), 55-63.

Elmasri, R., & Navathe, S. B., (1994) *Fundamentals of DATABASE SYSTEMS* (2nd ed.). (p. 185). CA:Addison-Wesley.

Gilbert, J. E. & Han, C. Y. (1999). Arthur: An Adaptive Instruction System based on Learning Styles. *In Proceedings of M/SET 99: International Conference on Mathematics/Science Education & Technology*, San Antonio, TX: Association for the Advancement of Computing in Education, pp. 100-105.

Guskey, T. R. & Gates, S. L. (1986). *Synthesis of research on masery learning.* Education Leadership, 43, 73-81.

Kolodner, J. L., (1993). *Case-Based Reasoning.* San Mateo, CA: Morgan Kaufmann.

Pasch, M., Sparks-Langer, g., Gardner, T. G., Starko, A. J., & Moody, C. D. (1991). *Teaching as decision making: Instructional practices for the successful teacher.* New York; Longman.

Reisbeck, C. K., & Schank, R. C., (1989). *Inside Case-Based Reasoning.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Russell, S., & Norvig, P., (1995) *Artificial Intelligence A Modern Approach.* (p. 151). NJ:Prentice Hall.

Russell, T. L., (1999) *The no significant difference phenomenon as reported in 355 research reports, summaries and papers. A comparative research annotated bibliography on technology for distance education.* North Carolina State University: Office of Instructional Telecommunications.

Salton, G., (1989) *Automatic text processing: The transformation, analysis, and retrieval of information by computer.* Addison Wesley, Reading, MA.

Sarasin, L. C., (1998), *Learning Syle Perspectives: Impact in the Classroom.* Madison, WI: Atwood Publishing.

Woolfolk, A. E., (1998). *Educational Psychology.*(7th ed.) (p. 334) MA:Allyn & Bacon.

The IN-TELE Project: Developing Internet-Based Teaching and Learning in Europe

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Abstract: The IN-TELE project, funded by the European Commission, is a two-year research project running from January 1998 to December 1999. This article focuses upon the design and implementation of the IN-TELE Teacher-Training Course in 1998, and its further development by researchers at the University of Essex, UK in 1999. We discuss the key challenges of developing a teacher-training programme for use within four European contexts and discuss experiences and early outcomes. Although the project has worked with sixteen secondary schools in France, Germany, the UK and Sweden, IN-TELE aims to design Internet-based teaching and learning solutions which are generally applicable to 'average' schools throughout Europe.

1. Introduction

> 'Our solutions are developed for average schools, dealing with the problem of low budgets, the difficulty of lacking experience among teachers and authorities and the problem of teachers' serious fears of new technologies. [IN-TELE, 1997]

The use and availability of information communications technology (henceforth ICT) in European schools varies considerably between, and within, each of the member states, [1]. That ICT is increasingly on political, commercial and research agenda is apparent from the *Review of research and development in technologies for education and training 1994-1998*, [European Commission, 1998] which lists some eighty-six collaborative projects, involving twelve European member states, and five EFTA countries. Nonetheless, the pattern of development remains uneven, if exceedingly dynamic, varying between national provision, [2] to regional, local or even private initiatives [3].

The IN-TELE Project, is a collaborative research project involving three university-based research groups and two independent research organisations from France, (Université Louis Pasteur), Sweden (Centre for Information Technology in Northern Sweden, Umeå), Germany (Friedrich-Schiller Universität, Jena; FAST, Munich) and the UK (University of Essex). These groups worked in 1998-99 to create, apply and test the organisational, technological, pedagogical and psychological conditions for the development of media competence of students and teachers in Europe. The project had the following objectives: to create a conceptually innovative technological basis for Internet-based learning and teaching between participating schools tailored to specific educational strategies; to develop an integrated working environment using the Hyperwave Information Server (version 4.1.1); to develop and implement a curriculum for training teachers in the use of the Internet for teaching and learning; to provide psychological, pedagogical and media didactic support for the participating schools; and to supervise joint thematic projects between schools on aspects of European Identity, [IN-TELE, 1997].

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[1] See, http://europa.eu.int/en/comm/dg22/socrates/comenius/site/summary.html, and European SchoolNet, http://www.eun.org/

[2] See especially the National Grid for Learning in the UK, http://www.ngfl.gov.uk/; Lottery-Funded ICT Training Programme, http://www.teach-tta.gov.uk/ictmenu.htm; Preparing France's Entry into the Information Society, http://www.premier-ministre.gouv.fr/GB/INFO/DPRESANG.HTM

[3] http://europa.eu.int/en/comm/dg22/socrates/comenius/site/summary.html

2. The IN-TELE Teacher-Training Course 1998-1999: Overview, and developments

> 'The emphasis lies on teacher training, with the aim of increasing Internet competence, supply of hard and software, the realisation of Internet teaching projects, schools of all countries are involved in, and the evaluation of the effects of these interventions. Objectives of the teacher training are improving abilities of well-aimed information research, communication by e-mail, newsgroups and chats and programming with HTML…Additionally, current developments in the field of the new communication technologies are discussed and the relevant educational and psychological theories and methods are introduced' [Suckfüll *et al*, 1999]

Annex I of the IN-TELE Project programme specifies the general content of the teacher-training programme. The following general areas were considered to form a common 'core' curriculum:

- the history of the Internet;
- ways to get online;
- identifying, retrieving and using online resources;
- the differences between traditional teaching discourses and Internet-based teaching and learning: Scientific theories and results, practical experiences and pedagogical consequences;
- HTML authoring for designing Internet-based lessons across the curriculum;
- discussion of the problems of computer-mediated teaching and learning;
- how the Internet may be used as a means of European Identity construction. [IN-TELE, 1997].

Key objectives were for teachers to:

- identify, manage and use the Internet and Internet-based resources competently and effectively within the classroom to enable cross-cultural exchange;
- understand how the Internet may support and develop learning, and be able to *apply* this understanding to the specific subject being taught;
- understand and identify appropriate and inappropriate uses of the Internet, from examples identified by teachers and discussed within the training programme;
- understand and address issues of equality of opportunity; copyright, ethical, and other legal considerations. [Glasfurd & Vickers, 1998]

The IN-TELE Teacher-Training Course, designed by academics from the University of Essex IN-TELE team, had to be used in a variety of contexts, across differing national curricula, and be relevant to the learning needs of teachers working with the project - each with different levels of experience and competence. The course aimed to build key technical skills and competencies, to build teacher confidence in ICT use, and to provide clear examples of how the Internet might be used within the classroom to support and develop teaching and learning, and facilitate cultural exchange. The training, implemented in 1998, was structured through six 'learning through doing' sessions, each lasting between four to six hours, with additional in-school workshops and support available for the duration of the project in 1998-99. One hundred and fifty teachers, at sixteen European schools, participated in the training in 1998 on a voluntary basis, [4]. Responsibility for the implementation of the training and the in-school workshops rested with IN-TELE project partners in each of the four countries.

2.1 Designing for flexible learning

> 'flexible learning…provides students with the opportunity to take greater responsibility for their learning and to be engaged in learning activities and opportunities that meet their own individual needs.' [Wade, *et al*, 1994]

In designing the 1998 teacher-training course the research group at the University of Essex faced a number of challenges. The training could not exceed six training days because of limited project resources. The course had to be applicable to all areas of four differing national curricula, and address the very different levels of experience of ICT among the project teachers. It was essential, therefore, that the training should be flexible and provide a platform of core skills and competencies from which the teachers could progress as independent learners able to choose *when*, *where*, *how* and *how much* they learnt.

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[4] The numbers trained are as follows: UK: 53; France: 30; Germany: 51; Sweden: 16.

The six training days in each of the four countries were supported with a variety of course materials, which have been (or are in the process of being) translated into French, German and Swedish. The training materials included an HTML authoring course on CD-ROM; paper-based worksheets; and online resources. In addition, most of the schools working with the IN-TELE project were issued with a mobile Internet set [5]. A multi-media laptop computer forms an integral part of this, and enabled project teachers to work either on or offline from home or in school, this being of particular importance to schools with few resources.

2.2 Developments in 1999

Whereas the initial IN-TELE training was supported in each of the four participating countries by project staff working as trainers, the *final* training materials for commercial dissemination from the Autumn of 1999, are designed entirely for self-study. The revised IN-TELE Teacher-Training Course is browser-based, with fifteen supporting activities. Hypertext is used to enable users to follow the course in a variety of ways, working either on or offline. He/she may wish to work through the course from beginning to end, or just to dip into sections of specific interest: the path is not determined but flexible, again enabling users to progress as independent learners. The course includes relevant information for French, German, Swedish and English teachers, as well as more general information of relevance to European users. The course has a practical, 'hands-on' approach; the use of jargon is kept to a minimum. Throughout the course users are pointed to the most up to date information and to selective further readings. The course also includes experiences of teachers who worked with the IN-TELE Project in 1998-1999.

The revised course is comprised of seven sections. The structure is illustrated in Fig 2.

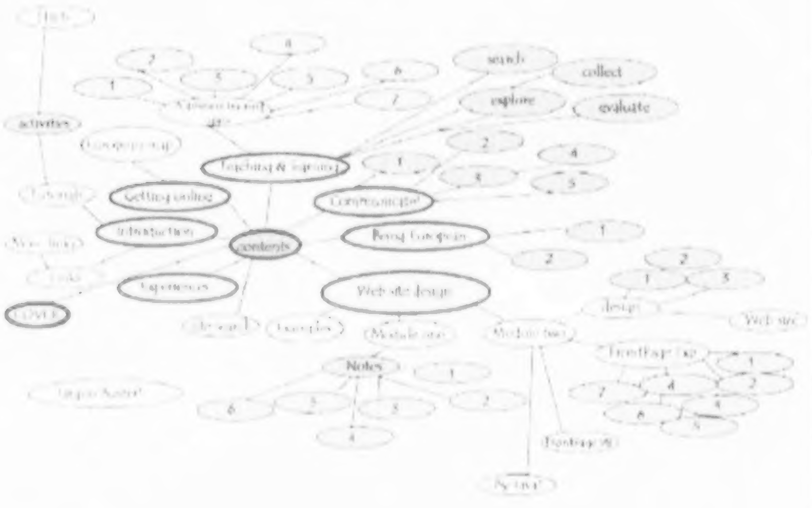

Fig. 2 IN-TELE Teacher-Training Course Site Map

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[5] The mobile Internet set is comprised of a multi-media computer, a video projector and a cart or trolley. The set was to include a Radio LAN, but this was unavailable throughout the project.

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2.3 Content of revised teacher-training course.

1. Introductory presentation and Introduction to the course
   Introduces the history of the Internet and outlines the aims and objectives of the training course;

2. How to Get Online
   Discusses the possibilities of getting online in a European context, including national educational initiatives; and how to make full and effective use of often limited school resources;

3. Using the Internet for Teaching and Learning
   The section explores the Internet as a qualitatively different learning space, in particular the ways in which the Internet may be used to:
   - Encourage active and independent learning;
   - Test ideas and encourage critical reasoning;
   - Enable communication within and beyond the seminar or class room;
   - Encourage subject exploration, information retrieval and network literacy;
   - Develop student creativity with text, pictures and sound;
   - Link knowledge and promote cross-curricular learning through the use of Hypertext;
   - Enable differentiation (e.g. use of Hypertext within Web pages to provide different pathways through a particular topic for students of differing abilities, and/or with different learning styles);

   There are four activities:
   1. Search! Explains how to search the Internet effectively.
   2. Collect! Explains how to save Bookmarks or Favorites for future reference.
   3. Explore! Searching specific Web sites for examples of Internet-based lessons.
   4. Evaluate! Evaluating the content of Internet-based lessons identified.

The activities are designed to build effective searching skills and to engage teachers from the outset as *critical* Internet users. Teachers have to consider how they might make use of or *consume* Internet-based resources, and also how they might *produce* resources themselves (in the shape of an Internet-based lesson) in the future.

4. Communicate!
   Considers how e-mail may be used to expand the boundaries of a classroom and support inter-cultural exchange and language learning. There are five activities to follow which discuss some of the challenges and opportunities of using e-mail within the classroom:

   1. Who's online?
   2. Opening a Web-based e-mail account
   3. Discussion groups and lists
   4. Meeting others and using interactive Web sites
   5. Language learning

5. Being European
   What does it mean to French, German, British, or European? What is our national identity comprised of? What makes us similar, what makes us different? How can the Internet help us to understand each other? Two activities support this section:

   1. Finding out about Europe
   2. Collaborate!

6. Designing Web sites for Student Learning
   This section is comprised of two modules.

   Module One: An HTML Authoring course: shows course users how to create a Web page with the minimum of resources. The activity involves users constructing a Web site on the topic Bangladesh Floods.

   Module Two: comprised of four sections:
   - Designing Web sites for student learning, with three supporting activities:
     1. Design Matters!
     2. Copyright
     3. Safety on the Web

- Creating Web Pages with FrontPage Express: shows how to use the free HTML editor FrontPage Express (supplied with the course) to create a web site in seven stages.
- FrontPage 98: introduces the main features of this sophisticated HTML editor.
- By Java, let's animate! Shows users how to create interactive Web sites using freely available Java Scripts on the Web.

7. Quotes from teachers who worked with the IN-TELE project reflecting upon their experiences.

3. Experiences

From September 1998 to June 1999, the teachers were asked to build upon the training provided by IN-TELE, to develop and integrate Internet-based lessons within the curriculum, and to work collaboratively with the project schools across Europe, considering European Identity themes and topics. Equipment in schools ranged from a networked computer room with sixteen PCs with Internet access, to use of the mobile Internet set: a single laptop computer with beamer.

All teachers who participated in the training were issued with a questionnaire, which asked them to reflect upon their learning experience with the IN-TELE project. In addition, teachers were asked to consider how their work with the project could be best supported locally (at their own school), nationally (by Government policy), and at the European level. Of questionnaires issued, just over a third were returned see Fig.1. Although the data is incomplete, and anecdotal, responses received illustrate several discernible trends and issues and these are discussed below.

Country	**Teachers trained**	**Lessons produced by June 1999** [6]	**Questionnaires returned**
France	30	5 (including for WP4)	11
Germany	51	6	14
Sweden	16	9	9
UK	53	21, + 11 student pages	18

Fig. 1 Summary of participation

4. Conclusion

The Internet-based lessons produced by teachers working with the IN-TELE project demonstrate a rich and varied use of the Internet as a teaching tool and learning environment. The work produced by teachers can be accessed via the four IN-TELE Project servers (UK, http://intele3.essex.ac.uk/; Germany, http://www.in-tele.org/; France, http://in-tele.u-strasbg.fr/; Sweden, http://intele.snic.se/) and is discussed in *D3.3 Trainers and Teachers' Internet Pages*, [Glasfurd, 1999]. Some teachers created interactive Web sites, others used e-mail to support pupils with learning difficulties; some teachers used the Internet as a source for ideas for lesson plans and professional development, and others for engaging pupils as active and independent learners. Some teachers have invested considerable time and energy in the creation of sophisticated Web sites as a whole and *immersive* learning environment which allowed for extension and/or differentiated activities, whereas others have used the Internet in a highly selective manner, integrating it within existing teaching materials and techniques.

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[6] This includes all completed projects. Responses to the questionnaire illustrate that there was considerably more activity than the figures above suggest. For example, there were many unfinished projects, which were not complete before the deadline of Deliverable D3.3, Trainers and Teachers Internet Pages.

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However, the work for the project was frustrated to a greater or lesser degree by a number of constraints. Teachers *in all four countries* experienced difficulties primarily associated with a lack of free time, and access to, or the functioning of, suitable equipment. Many felt that their institutions did not support their work with the project sufficiently (by making free time available in school time for them to work with the learning materials; or by making available additional equipment and technical support). At the national and European levels many felt that there should be more effort to supply equipment and provide training to schools.

The IN-TELE mobile Internet set, whilst enabling the use of Internet-based resources within classrooms with no network connection, cannot be used effectively to support some of the desired student learning outcomes associated with Internet-based teaching and learning. Responses to the questionnaires show teachers reporting problems of too few computers among too many students. Active and independent learning needs to be supported by *direct* access to networked computers by students working individually or collaboratively in small groups. A central aim of IN-TELE was to encourage and engage students and teachers in cross-border communication. Open access to e-mail by both students and teachers is an important requisite in enabling full and open communication. At one UK school, where the only access to the Internet was via the project laptop linked to a telephone line in a secretary's office, concrete collaborative work was nearly impossible.

The IN-TELE training course is intended to provide teachers with a set of core skills and competencies; and provide a programme of study, which could be broadly applied to other European countries. The experience of the project has illustrated that although this strategy and approach has been relatively effective, successful outcomes do not rely just upon individual skills levels or the motivation of each teacher participating in the training. The context within which the teachers work - including the management culture of institutions, the priority given to ICT and their support by regional, national and European governments and educational authorities - plays a crucial part in determining outcomes.

References:

[IN-TELE, 1997] IN-TELE, (1997) *Annex 1 Project Programme: IN-TELE Internet-based Teaching and Learning.* Unpublished.
[European Commission, 1998] European Commission, Directorate-General Telecommunications, Information Market and Exploitation of Research (1998), *Review of research and development in technologies for education and training 1994-1998*. Office for the Official Publications of the European Communities, Luxembourg.
[Suckfüll *et al*, 1999] Suckfüll, M., Frindte, W., Köhler, T., Liebermann, J., & Stauche, H., (1999), IN-TELE deliverable D5.2, *Intermediate Report: Internet-based teaching and learning*, pp 6-7.
[Glasfurd & Vickers, 1998] Glasfurd, G., & Vickers, A. J., (1998) *The IN-TELE Teacher-Training Course: An Overview.* Actes d'IN-TELE 98 - Colloque européen sur les usages pédagogiques d'Internet et sur la construction de l'identité européenne, eds, P. Marquet, S. Mathey, A. Jaillet. Peter Lang: Berlin, forthcoming.
[Wade, *et al*, 1994] Wade, W., Hodgkinson, K., Smith, & A., Arfield, J., (1994), *Flexible Learning in Higher Education*, Kogan Page Ltd.: London, p 12.
[Glasfurd, 1999] Glasfurd, G., (1999), IN-TELE deliverable D3.3, *Trainers and Teachers Internet Pages.*

Web sites:

European Co-operation on School Education: Summary of country report on IT in school.
http://europa.eu.int/en/comm/dg22/socrates/comenius/site/summary.html
European SchoolNet
http://www.eun.org/
National Grid for Learning
http://www.ngfl.gov.uk/
Lottery Funded ICT Training Programme
http://www.teach-tta.gov.uk/ictmenu.htm
Preparing France's Entry into the Information Society
http://www.premier-ministre.gouv.fr/GB/INFO/DPRESANG.HTM
IN-TELE: http://www-in-tele-org/; http://intele3.essex.ac.uk/; http://intele4.essex.ac.uk/; http://in-tele.u-strasbg.fr/
http://intele.snic.se/

Multimedia Interfaces for E-Commerce

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Abstract: E-Commerce, when viewed as a network of multimedia data transactions, is a sophisticated application of multimedia information authoring, retrieval, searching, browsing, clustering, and navigation. This paper analyzes the role of each of these multimedia technologies in the context of E-Commerce.

1. Introduction

"Electronic Commerce" or "E-Commerce" refers to the use of computer networks to exchange information in commercial transactions, whether in form of prices, orders, advertising, authentication, or electronic goods. The computer networks involved can be private or public, local or global; the Internet is a prime example. Multimedia data in E-Commerce can be actual goods, such as images, sound or video recordings, but also be used as interface elements to facilitate the exchange of physical goods. Electronic Commerce depends on the transmission of information goods and services; viewed as a network of multimedia data transactions, this introduces new challenges to the field of multimedia. This paper analyzes multimedia interfaces from the E-Commerce perspective and describes how these technologies need to be adapted to benefit E-Commerce.

While many factors drive the growth of electronic commerce, equally many social problems inhibit it. Growth is accelerated by technological advances such as improved network infrastructure and data access that lower transaction costs and expand markets. It is stunted by the lack of standards and easy-to-use interfaces: for example, the format of Electronic Transactions is still fluid as digital certificates such as E-pass are still evolving and have not yet been standardized. Only basic mechanisms of digital cash and data protection have been accepted, as models and mechanisms that fit businesses are still in flux, lacking sufficient market analysis.

These problems reinforce the resistance of many companies to conduct business on the Internet. The lack of standards has been compounded by the changing nature of the Internet and the lack of a sufficient number of prototypes to serve as benchmarks. Various industry sectors respond and benefit differently; extensive research is needed to convince them of the potential revenue generated by this new type of commercial market, and to show that it can exceed traditional services. Research in various industry sectors like finance, pharmaceuticals, publishing, and retail sales can identify the driving forces behind each one.

Traditional forces still govern most manufacturers, distributors, and product designers who choose to base commercial success on face-to-face transactions. It is still not clear, from the limited applicability of existing multimedia technologies on the Web, how face-to-face transactions can co-exist and evolve with computer-based transactions. In fact, most business decision makers view E-Commerce as a non-effective tool to advertise their products because it is based on a non-push technology, the Web. Unlike television advertisement, which comes as part of a station's program, Web-based advertisement is server-based and therefore depends on where consumers direct their browsers, instead of being part of the data stream that consumers receive from their ISP.

Although the Web is at present a passive mechanism for selling products, it can offer both sellers and buyers other, more long-term benefits such as valuable consumer information, purchase opportunities, and educational experiences or interactivity. Once companies and consumers understand this better, E-Commerce will gain as a commercial platform. Futhermore, television advertising has a very high cost and non-lasting effect when compared to accessing product information on the Web. What is needed is a better understanding of how television and the Web can be combined for synergistic impact. For example, accessing television advertisements via the Web, or accessing the Web by way of television advertisements, can give viewers new avenues of interaction and feedback.

Another significant issue is the background necessary to conduct E-business. New approaches and strategies are needed in training managers, consultants, and clients in communicating and interacting. This is a complex problem. As research is conducted on a set of key virtual communities in E-business, patterns will evolve which will become valuable insights.

2. Key Factors for Multimedia Interfaces

We believe that multimedia user interface technologies will play a key role in the development of E-Commerce. Therefore, existing multimedia tools must be reconsidered in the light of E-Commerce, and specifications drafted on how to adapt such technologies to provide significant additional benefits to the consumer. At the same time, traditional commerce parameters must be upheld, and concerns of security addressed. Only if these conditions are met, multimedia interfaces can help the growth of E-Commerce.

The Quality Factor

Since it is the business decision makers who drive E-Commerce, technology developers and multimedia experts must show the decision makers that the multimedia data access tools have additional, enriching features that make E-Commerce competitive. This "Quality Factor" may mean a variety of tool adaptions: for instance, image or audio servers may want to include watermarking or other authentication and copyright facilities. Ease of use and scalability are very important. To measure market compatibility, benchmarks and other mechanisms of comparison are needed. Retrieved or browsed data needs to be easily analyzed, assessed, or compared to other goods.

The Assurance Factor

To improve acceptance and productivity, E-Commerce is required to be compliant with legal, commercial, and financial principles. Automating part of this "Assurance Factor" is important, so multimedia technologies must incorporate measures that deal with non-technical constraints. Authoring tools would require ways to check raw materials prior to use and verify their proper commercial identification and credentials such as authenticity, copyright clearance, and market value.

The Security Factor

Since E-commodities may deal with sensitive information such as images, video, medical records, insurance records, or legal documents, "efficient data processing", traditionally describing speed and accuracy of transactions, must also measure robust and secure communication. Transactions must ensure customers' privacy and protect sensitive information, but also check for violations in privacy, security, access privileges, and data protection on both the customers' and the providers' side.

3. Authoring and Retrieval

The success of commercial information transactions is mostly based on two issues: how well the information can be retrieved, and how well it can be presented. The technologies that affect these issues the most are Multimedia Authoring (MMA) and Multimedia Information Retrieval (MMIR).

The goal of MMIR is the seamless access to heterogeneous types of data and the ability to retrieve specific, multi-modal information, as expressed in the form of a query, either by describing the target (text query) or giving similar objects as examples (media-based query). On the other hand, the goal of MMA technologies is to build or compose new multimedia documents or applications from existing or retrieved information. Authoring should be an integral part of any dynamic commercial venture that enables a consumer to express decision making, be it as simple as adding a check mark to a table to indicate interest, or as complex as designing an architectural draft of a new house plan. Authoring is integrally associated with retrieving information from a constantly changing knowledge database, whether the goal is to author for retrieval (to create a new knowledge database) or to retrieve for authoring (to use the database for creating new documents). It is important to avoid excessively large or complex documents that are difficulty to manage or query ("authoring beyond retrieval"), and to guard against retrieval problems where results are in a form that is not easily assembled, classified, clustered or composed with other information into comprehensible self-standing modules.

Linking information retrieval with authoring can prevent "authoring beyond retrieval" and retrieval problems. In the case of authoring, mechanisms for automatic segmentation and indexing of multimedia objects capture or encode changes of document structure. One way to achieve this is by using "tagging" during the authoring process: a lecturer recording a talk on video could use automatic facilities to indicate changes of structure in his lecture, aiding later retrieval. Retrieved information "units" must be of a size that is easily assembled and built upon, therefore the granularity of the information retrieved must be adapted for authoring.

Cross-Modal Information Retrieval

For practical E-Commerce applications, most MMIR tools are still in a primitive state and cannot derive accurate information. Text-based queries are far more mature than media-based queries which need to be translated into low-level attributes that the retrieval system can recognize and mechanically search for.

Computed Alignment is a method to align two diverse media streams of information so that a query in the "easier" media type (usually text) yields the corresponding segment in the other, more complex media type (such as audio or video data). An example is the transcript and the audio recording of a speech: by aligning the text with the audio, passages in the audio stream can be found with simple text queries. Computed Alignment is an intermediate solution to the difficult problem of retrieving information "across modalities" from multimedia databases.

By employing CMIR via Computed Alignment, E-Commerce applications can provide simple interfaces for serving stream-based multimodal information. Automated alignments allow frequently changing databases to be prepared easily, e.g. a news station can align transcripts to audio or video segments of interest to provide "custom news" for clients. Three potential E-Commerce applications of Computed Alignment are Text-to-Speech Retrieval, Slide-to-Video Retrieval, and Parallel Text Alignment.

— Text-to-Speech Retrieval, as mentioned above, synchronizes speech audio with its textual transcript that has been derived from a separate source. Queries for passages in the audio can now be formed as textual queries and located easily. Applications include court and other legal proceedings, language instruction audio tapes, entertainment materials, lectures and courses, etc.

— Slide-to-Video Retrieval: given a video presentation and the corresponding slides in digital form, a query might ask for the video segment corresponding to a particular slide. The slide images are aligned to the video images of the slides using fast image processing techniques and a discrete formulation of the general theory of cross-modal information retrieval mentioned previously. With large video presentation libraries, such a media-based query (i.e., by slide) can be very useful to retrieve video segments of interest, e.g. for employee training.

— Parallel Text Alignment (PTA) provides tools for the automatic alignment of two or more textual documents that have been separately derived from a shared source, such as different translations of ancient works. PTA can be used to retrieve points in these translations that relate to the same original source location, even when this source is not available. Applications include tracking different versions of product documentation or comparing translations from different languages that deal with the same event.

Computed Alignments can also serve to anchor various meta-notes and thus permit metadata queries. Cross-modal infrastructure of this sort can make multimedia data processing a valuable assent for future E-Commerce growth.

4. Searching and Browsing

Search engines are a primary means of locating new information on the World Wide Web today. Search engines evaluate the relevance of a user's description (usually a string of keywords) to each item in a collection and present the results of this evaluation to the user. The standard for presentation of results in search engines is a ranked list of results, with order based on a calculated relevance score. Depending on the narrowness of the search, the size of the information pool indexed by the engine, and the search engine's algorithm, typical results are a few to hundreds of thousands of matches. Search engine users typically browse these results in search of potentially good matches for their original queries. So far, we discussed retrieval and authoring. How about browsing?

'Searching' and 'browsing' are recognized as complementary but mostly separate approaches for information access. Browsing is like leafing through a magazine and searching is like turning to a specific article directly. Both are valuable information access ways especially needed for E-Commerce applications. "Browse engines" is a term coined at the DEVLAB (Dartmouth) to denote a class of information tools that permits convenient access (indexing) to World Wide Web resources. Browse engines work much like search engines to provide a useful summary of Web resources; they resemble search engines in being based on previous surveys of Web material, and not on active, on-line access to the Web. They differ in being designed to facilitate browsing instead of just searching of World Wide Web materials.

While search engines use search techniques to locate resources, the interface they present to a user typically requires browsing. Search engines have facilities for indexing text and providing URLs whose associated text matches search text. However, search engines do not make it convenient to assess the contents of Web materials quickly and interactively. Links presented by a search engine must be chosen for closer inspection or ignored based on incomplete text snippets; further, finding out if the material they link to is significant requires initiating and waiting for connections to Web sites.

Browse engines are like search engines in that they index Web material, but their presentation includes formatting, links, and reduced-quality graphics. This makes it possible to evaluate Web materials as they appear, and to browse search results by following links between documents—all without incurring the overhead of online connections to retrieve materials.

Because of the greater difficulty in storing images, links, and other content, browse engines are intended for topic-specific use or one-time scans. For example, one might establish a browse engine for a specific area like Macintosh computer maintenance that would be kept up-to-date by daily Web crawls. Alternatively, one might "launch" a browse engine daemon to run overnight and build a one-use browse engine for an interesting topic, permitting a convenient assessment of Web materials on the topic when its scans of the Web are done.

The idea of a browse engine is similar to that of pre-fetching: in anticipation of user need, pages are downloaded from the World Wide Web and archived. A difference is that instead of caching the few pages most likely to be requested soon, the engine stores all the pages it can find, using a reduced form, and optionally makes this information available to multiple users. This allows better presentation of results, with links, clusters, and summaries as possible features. For some tasks, it also makes possible a more effective and efficient World Wide Web information retrieval system than is currently available.

Yahoo and Infoseek incorporate categorization approaches similar to those used in library catalogs to make users' browsing easier. These systems require manual classification to make this approach feasible, however. The browsable catalogs are mainly links with small snippets of associated text, although new services like the Yahoo Image Surfer provide searching and browsing of images, along with links to access their source World Wide Web pages. The Yahoo Image Surfer presents a thumbnail picture and Web page title for each image entry in its browsing interface, but no further indication of the content of the page.

Results of searches can also be presented in more complex ways. The graphical visualization interface "Envision" makes two dimensional plots of icons representing publications along user-selected axes. Rankings can be by estimated relevance, publication type, index terms, author, or publication year. Estimated relevance is also used as a third dimension, expressed either through color or shape of document icons. Clustering results and displaying descriptions and representatives of each cluster is another potentially useful technique for organizing and presenting results.

Current work on improving speed in this area has focused on pre-fetching and caching using proxy servers. There is work concerned with improving caching strategies (Krishnamurthy, Reddy) and extending proxy servers to handle temporal media like audio and video (Tewari) and with reusing or "caching" network connections (Osawa) so that a sequence of requests can be serviced over a single connection. None of these approaches use new types of servers specifically targeted at browsing summary information. E-Commerce applications will require development of fast browsing engines which incorporate intelligent compression techniques for web pages, visualization of a degraded version of a web page during browsing, caching and proxy server techniques, and statistical analysis of Web usage patterns which feed into a browse engine system.

5. Clustering and Navigation

As the content of cyberspace grows exponentially, it becomes increasingly difficult to construct predefined tools that effectively support navigation and exploration of this information space. This means that the computer will have to become a much more proactive element in navigation by generating content- and context-aware navigational tools based on the user's current environment. Techniques based on automatic recognition of structure and content of the Web will become increasingly important. Unfortunately, today's implementations of these systems still need too much human intervention to be useful. Automatic organization of retrieved or authored multimedia information requires tools for clustering (grouping) related information in a multimodal sense: not just images that look alike but images and text segments that describe similar things. Multimodal clustering is an unsolved problem.

Cybermap is a new tool which automatically generates overview maps for textual documents. It creates a graph of a collection of nodes by clustering related documents by content into nodes as well as automatically generating links between semantically-related nodes. The resulting graph can be viewed in multiple representations, providing for quick access to information and data filtering in the Web. Cybermap incorporates the concept of hyperdrawers as a means for partitioning nodes into ordered sequences.

In addition to retrieval, browsing, authoring and clustering, E-Commerce requires easy navigation of the information space and a mechanism to track or keep a record of such navigation. Cybermap either complements existing navigational aids for hyperdocuments or provides a self-sufficient navigation tool for browsing the Web. In addition, it offers the capability of horizontal growth and easy hypertextualization of nonhypertextual documents without restricting the use of already installed browsing mechanisms.

Desirable Cybermap Extensions

Automatic clustering of multimedia documents is not only a valuable organizational tool but also important for retrieval, browsing and authoring. Cybermap is one of the first such clustering tools developed for efficient browsing and navigation, even before the Web was developed. Its clustering capabilities have been demonstrated with large databases of textual keywords, images and audio sounds. The following extensions to Cybermap represent work in progress:

a) a filter that extracts keywords based upon which clustering can be performed.
b) a map-drawing facility that develops a graphic of the history of searching or browsing performed.
c) a security mechanism for checking authenticity of multimedia data item as they are added to a cluster; requests with certain traits fall into different categories and alarm systems go off when a particular situation is reached.

d) a visual interface that allows private and public annotations next to each cluster or automatic linking to a commercial (such as medical/pharmaceutical) atlas.
e) a help facility for altering the parameters based on which clustering is done or changing the average size of the cluster, or changing the types of data acceptable.

6. Sample Application: Courseware and Museum Content

Learning commodities is a familiar scenario in the case of distance learning. However, assessing the commercial value of courseware information in the context of E-Commerce is different as the quality, assurance, and security factors discussed earlier need to be taken into account.

For example, given a set of lectures in computer science, there are video, audio, textual and other components that are either in the form of aligned tracks or presentations, or separate documents, or both. Trading a whole course or a whole lecture is one way of segmenting the value of the exchange. Another way is to look at this from a digital library point of view, i.e. pay by access, pay by view, or pay by minute. Similar questions arise in other applications, such as viewing medical records for the purpose of training, investment portfolios, artistic images, etc. In all these cases, the technologies we mentioned earlier are involved. If retrieval is inefficient, any "pay by access" strategy will fall apart. Thus, commercial scenarios based on "pay by view" etc. depend on how robust the multimedia infrastructure is.

Consider museum content as an educational commodity. It can be viewed as a resource or service of artistic or cultural value that must continuously be enriched, managed, maintained and interacted with by a diverse set of users, both locally and distantly. Museum objects may include books, painting, statues, archived information, lectures, audio tours, etc. Providing the user with an automatic museum object management retrieval, requires effective workflow agents sensitive to constraints imposed by the content providers the employer or the donor of a collection.

7. Other E-Commerce Technologies

Workflows

Commercial workflow systems, mostly used in banking, describe business processes as service requests (the workflows) and service providers (institutions, individuals, and other components of a business). Workflows eliminate duplication of effort, exploit parallelism, and reduce costs, processing, and delays. In designing a workflow, a diverse set of components (such as organizations, individuals, documents, and deadlines) must be integrated over a wide area network connecting the participating institutions.

Agents

Intelligent software agents can automate transactions and reduce time and costs. In a networked marketplace, agents can represent customers who make selections, request information, or offer contracts; providers who offer services, features, or product choices, and assess buying capabilities and authentication; or goods and services being exchanged. There are a multitude of legal issues arising from the digitization of valuable materials which need to be disseminated widely and fast. Copyright management tools must be developed and built into the access mechanisms of retrieval and authoring. There are several security levels which one must consider:

a) how to secure the actual documents by encryption of the materials to prevent malicious destruction or alteration or unauthorized access;
b) how to provide document identities to possibly complex multimedia documents (such as a video that is annotated with music);
c) how to keep track of materials usage, important in generating fees. Tracking materials usage is done by controlling access, using passwords, and a form of digital signature generation;
d) how to generate payment, provided that there is a good way to measure or quantify the use of the materials.

Trading using a query language would enable customers to search for information based on a variety of parameters (duration of course, difficulty level, number of images, number assignments, etc.) Notification services can be used to notify customers of course or materials services. A transaction management system keeps track of all transactions for any one site. Repository services store information in different manners. Payment and banking services manage the transactions and complete the payment using a bank.

8. Conclusion

Thousands of organizations and millions of individuals will soon depend on a dynamic, heterogeneous market economy of multimedia transactions. Vast amounts of diverse data (animation, images, audio clips, tables, etc.) will need to be processed and stored daily, in raw databases, digital libraries, websites, commercial databanks. The demands of the public are growing and must be met. New commercial applications are mushrooming in all fields: medicine, environmental studies, finance, humanities, and law are all seeking good retrieval methodologies to enable fast decision making.

References

Renu Tewari, Harrick M. Vin, Asit Dan, and Dinkar Sitaram. Resource-based caching for Web servers. *Proceedings of SPIE Multimedia Computing and Networking 1998*, pages 191-204, San Jose, California, January 1998.

Fillia Makedon and Charles Owen. Cross-Modal Retrieval of Scripted Speech Audio. *Proceedings of Multimedia Computing and Networking 1998*, SPIE'98 San Jose, CA, January 26-28, 1998.

Soon-Yong Choi, Dale O. Stahl and Andrew B. Whinston. Economics of Electronic Commerce. *The Essential Economics of Doing Business in the Electronic Marketplace*, Macmillan Technical Publishing, 1997.

Ravi Kalakota and Andrew B. Whinston. *Electronic Commerce: A Manager's Guide*. Addison-Wesley Publishing, 1997.

Carol Ann Charles (Editor), et al. *Globalizing Electronic Commerce: Report on the International Forum on Electronic Commerce*, Beijing, China, 20-21 March 1996.

F. Makedon, J. Ford, C. Owen, and S. Rebelsky. Interactive Multimedia Publishing Systems. Chapter in *Multimedia Tools and Applications*, Borko Furht, ed., Kluwer Academic Press, 1996.

Patrick G. McKeown, et al. *Metamorphosis: A Guide to the World Wide Web & Electronic Commerce: Version 2.0*. 1997.

NSF Workshop on E-Commerce Sponsored Computation and Social Systems (CSS) Program National Science Foundation September 10-12, 1998, At The IC2 Institute The Univ. of Texas at Austin, Austin, Texas http://cism.bus.utexas.edu/

Peter G. W. Keen, Craigg Ballance. *On-Line Profits: A Manager's Guide to Electronic Commerce*. 1997.

Walid Mougayar. *Opening Digital Markets: Advanced Strategies for Internet-Driven Commerce*. 1996.

Walid Mougayar. *Opening Digital Markets: Battle Plans and Business Strategies for Internet Commerce*. McGraw-Hill; ISBN: 0070435421

Daniel Minoli, Emma Minoli. *Web Commerce Handbook*. McGraw-Hill Series on Computer Communication, 1997.

David R. Kosiur. *Understanding Electronic Commerce (Strategic Technology Series)*. Microsoft Press; ISBN: 1572315601

THE CHALLENGE OF DESIGNING AND EVALUATING 'INTERACTION' IN WEB-BASED DISTANCE EDUCATION

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INTRODUCTION

The World Wide Web (WWW) is increasingly being used as a medium to deliver distance education at the post-secondary level. However, an examination of a significant number of web-based courses for adult learners indicates that they are predominantly designed to transmit information to the learner rather than foster the teaching and learning process in a dialogic manner. These courses disregard Knowles'(1990) principles of andragogy especially the principle of using the adult learner's experience in a learning situation, and lack the design of interaction that promotes collaborative learning. This view was confirmed by Boshier et. al. (1997) in their survey of web-based courses for adult learners. They note that while the web holds considerable potential for learner interaction, few courses use much of its interactive capability. Most do not provide opportunities for collaborative learning. They note that the chief difficulty is not technological, but conceptual, as many instructional designers or teachers are obsessed with objectives and the assessment of students and arranging information in a hierarchical order. They have unwittingly or naively endorsed a transmission model of learning similar to what happens in a traditional or face-to-face classroom.

If the web is to be used as a versatile medium for adult learning, then, careful attention must be paid to the design of interaction that can foster the negotiation of meaning, the validation of knowledge, and the construction of knowledge through social negotiation. Learner - centered learning environments based on constructivist principles where the focus is on learner initiated inquiry and exploration are far more suitable for adult learners than the transmission model of learning which is based on the notion that learners are empty vessels to be filled up with the teacher's knowledge. Constructivist learning environments provide multiple perspectives and real world examples, encourage reflection, and support collaborative construction of knowledge through social negotiation (Jonassen, 1994). Instructional design models based on behaviorist principles that are used to design and develop instruction for traditional classes do not offer much guidance for the design of instructional strategies for two-way interactive distance education systems. Instructional designs must address the complex interrelationships between learning task, media attributes and the learner's cognitive processes. The design of interaction that facilitates adult learning and the evaluation of the learning experience that occurred as a result of that interaction has been a challenge to many web designers.

THE PURPOSE OF THIS PAPER

The purpose of this paper is three fold: 1) to discuss issues related to the design of 'interaction' on the web using models of interaction developed for distance education, 2) to examine several techniques for the analysis of interactions and the quality of the learning experience in a computer-mediated group conference, and 3) to propose a model for analyzing the social construction of knowledge in such a group conference. The paper provides guidelines for both designers and evaluators of web-based instruction.

The paper will examine the definition of 'interaction' in a computer-mediated communication (CMC) environment as definitions of 'interaction' for interpersonal communication used by communication researchers to study face-to-face dialogue do not transfer well to the CMC context. The paper will point out the strengths and shortcomings of interaction analysis techniques that have been developed and will propose a model for analyzing the quality of CMC interactions and learning experiences. The application of this model for analyzing interaction will be discussed briefly.

DESIGNING INTERACTION IN WEB-BASED INSTRUCTION

The issue of 'interaction' has been an area of much debate in the practice of distance education. Often debated questions are: What type and level of interaction is essential for effective learning? How can we achieve interaction? What does synchronous (real - time) and asynchronous (time - delayed) interaction contribute? What type of interaction can the new interactive technologies provide? Is it worth the cost? Designers need to keep these questions in mind as they grapple with the task of designing 'interaction' for the web.

Examining instructional interaction in distance education, Moore (1989) makes a distinction between three types of interaction: learner- content interaction, learner- instructor interaction, and learner- learner interaction. This model serves as a useful guide for designing interaction in web-based instruction. Dinucci, Giudice, and Stiles (1998) discuss interactivity in web design as falling into three categories: users interacting with the web site itself, which is similar to learner - content interaction, users interacting with the site's publisher, similar to learner - instructor interaction, and users interacting with each other, similar to learner - learner interaction. They provide design guidelines for all three types of interaction using the unique technological capabilities of the WWW. The design issues related to these three types of interaction will be discussed in this section.

The interaction between the learner and content is the process of intellectually interacting with content that results in changes in the learner's understanding, perspective, or the cognitive structures of the learner's mind. This type of interaction could also be considered as 'system interactivity' when students work with a web-based instructional program where the system may adapt to their inputs or interactions.. Hyperlinking by which students navigate through the web, as well as web pages that interact with students by changing their form and displaying new information in response to the position of the cursor or to mouse clicks are ways in which learner - content interaction can be designed taking into consideration the unique features of the web. The multimedia capabilities and the hypertextual navigational tools of the web not only provide access to multiple perspectives but also provide some degree of control to learners as they try to make sense of the content.

The second type of interaction Moore (1989) describes is the interaction between the learner and the instructor, a type of interaction that is regarded as essential by many educators and highly desired by many learners. He states that the instructor is especially valuable in responding to the learners' application of new knowledge. Learners do not know enough about the subject to be sure that they are (1) applying it correctly, (2) applying it as intensively or extensively as possible, or (3) are aware of all the potential areas of application. 'It is for reality testing and feedback that interaction with an instructor is likely to be most valuable.' (Moore, 1989, pp. 3-4). In the web-based environment, this type of interaction can take place either between the individual learner and the instructor via private e-mail, or between a group of learners and the instructor in a group conferencing situation. The web-based environment is versatile in being able to provide for these types of interaction in a synchronous format (real-time audio, video, or text, or a combination of them), or in an asynchronous manner (time-delayed text).

Dinucci, Giudice, and Stiles (1998) observe that one of the most simplest and useful ways to open lines of communication between the learner and the instructor is including an e-mail feedback form using the 'mailto' feature built into HTML. However, 'mailto' only generates a message form and if the instructor requires more detailed feedback from the students, the designer may want to create fill-in forms. They note that creating such a form can be handled by standard HTML 2.0 code and by drag-and drop controls in most WYSIWYG HTML editors. Although you can create the form using HTML, in order to use the form interactively you need to use a programming language such as JavaScript. They note that JavaScript event handlers can be used with any form element to trigger interactions. Event handlers are commands that trigger actions whenever a certain event occurs - either an interactive event, such as the user clicking a button, or a noninteractive event, such as a page loading. When the event happens, the event handler can be used to run a JavaScript function in response to it. With new browsers, for example, those that support HTML 4.0 event handlers become really powerful. Any object on a page can react to user actions, as event handlers do things like trigger sounds and animation. Another method used to add interactivity is the use of plug-ins such as Shockwave for Director and Shockwave or Flash. However, the drawback is that learners have to have the plug-ins or be willing to download very large files. These more sophisticated techniques provide the combination of learner - content interaction and learner - instructor interaction. However, using more sophisticated technology on the web may prevent access for those learners who have a low end computer or internet connection. This is a factor that must be considered carefully by those who design web instruction for distance learners.

The third type of interaction, is the interaction that takes place between one learner and other learners, alone or in group settings, either in the presence or absence of an instructor. Moore (1989) notes that this type of interaction is a new dimension for distance education and will challenge our thinking and practice in the 1990s. It is also this type of interaction that would contribute immensely to a learner-centered view of learning, and provide the opportunity for the social negotiation of knowledge and construction of meaning. It is the evaluation of this type of learning that poses a critical challenge, and guidelines for this type of evaluation is presented in this paper.

It is the capability of the web to provide both chat sessions and forums for building communities, that is of most interest to adult educators who want to design instruction based on constructivist principles. These can be both synchronous or asynchronous. The 'Chat' feature allows learners to exchange text messages with other learners and the instructor in real time. The standard Internet protocol for chat is the 'Internet Relay Chat (IRC). Forums are asynchronous conferencing environments such as Netscape's Collabra or the WWWboard which are web-based, or stand alone online conferencing programs such as Lotus Notes or First Class. Most chat environments use a text-based interface, while some provide sound capabilities as well. As Dinucci, Giudice, and Stiles (1998) note newer systems offer graphic stand-ins called 'avatars' which users can use to represent themselves online. Others use VRML to create interactive 3D spaces in which your avatar can actually walk up to other users (or to their avatars) and exchange conversation, usually as text strings displayed in the window. However, these fanciful 3D environments may not be what the adult learner needs, and designers must carefully distinguish between the glitz and the goal of facilitating learning.

In order to enhance 'social presence' designers can add real-time videoconferencing such as CU-Seeme and NetMeeting. However, social presence can be facilitated in a text-based conferencing system without the addition of video by training the communicators involved in the communication transaction (Gunawardena, 1995). Gunawardena and Zittle (1997) have shown that social presence is a predictor of satisfaction in a text-based conferencing environment. Videoconferencing applications are not part of the web yet, but can be launched as helper applications or as browser plug-ins. One of the aspects that the designer needs to keep in mind is the limited bandwidth available for videoconferencing and issues related to access.

The design of asynchronous learning environments that facilitate interaction among learners and between the instructor and learners in a virtual group, is discussed elsewhere in detail (Gunawardena, 1998). It is the evaluation of learning that takes place in such an environment that is of interest to this paper and is discussed in the following sections.

Hillman, Willis, and Gunawardena (1994) argue that Moore's (1989) three types of interaction do not account for all aspects of interaction in technology-mediated distance education. They point out that the addition of high technology communications systems necessitates the conceptualization of an additional type of interaction: learner-interface interaction. They note that a facet of distance education that is increasingly overlooked is the effect of high-technology devices on interaction. Instructors and learners have to interact with the technology and manipulate interfaces in order to be able to communicate with each other. They state that it is important to make a distinction between the perception of interface as an independent, fourth mode of interaction, and the use of an interface as a mediating element in all interaction. In distance education, the interface itself is unlikely to be relevant to the subject being studied; it merely acts as a confounding intermediary between the three previously mentioned modes of interaction. The interface in this case has become an independent force with which the learner must contend. The web is a new medium for many adult learners an instructors and therefore designers must pay careful attention to training both instructors and learners to use this new medium if effective instruction is to take place. In order to address the learner-interface problem, Hillman, et al. (1994) suggest three types of activities to make the learner and instructor at ease with the technology. These include in-class exercises, orientation sessions, or technology credit courses.

In summary, the previous section has discussed issues that web designers need to consider if they are interested in facilitating the teaching -learning process for adults. It has provided guidelines for the design of three types of interaction discussed by Moore (1989), and the fourth type of interaction discussed by Hillman et. al. (1994). The following sections discuss several techniques for the analysis of interactions and the quality of the learning experience in asynchronous group conferences that facilitate learner - learner interaction, and propose a model for analyzing the social construction of knowledge in such a group conference.

EVALUATING INTERACTION AND THE QUALITY OF THE LEARNING EXPERIENCE IN GROUP CONFERENCING

A number of models for the evaluation of quality in computer conferencing are available. Hiltz (1990) describes analysis of the use of computer technology along four dimensions: 1) characteristics inherent to the technology, 2) social and psychological characteristics of users, 3) characteristics of groups adopting the technology, and 4) interaction of the preceding factors. Levin, Kim and Riel (1990) describe a method of analyzing the structure and content of interactions by the creation of 'message maps' which display graphically the interrelationships among the messages submitted to a conference. Levin, et al. use this analysis to identify 'threads' within a conference and to display the 'multithreaded' nature of conference interaction. They also practice identifying messages which are particularly 'influential' in producing numerous responses or lengthy sequences of responses and they diagram message flow described as the ebbing or flowing volume of messages in the conference. Henri (1992) proposes a system of content analysis which involves breaking messages down into units of meaning and classifying these units according to their content. Henri includes a quasi-quantitative 'participative' dimension of analysis in her scheme for content analysis which the authors feel is more properly considered as a separate issue from the more qualitative analysis of message meaning units. Henri's other four broad categories of content are described as 1) content which reflects the social dimension of conference interchanges, 2) content relating to the interactive dimension of the conference, 3) content indicating the application of cognitive skills, and 4) content showing metacognitive skills.

These models serve as a useful starting point for analyzing group interactions but one of the shortcomings of these models is that no specific criteria have been established for determining the quality of those interactions. Moreover, the definitions of interaction these models present are either unclear or not very applicable to the pattern of interaction observed in group conferences. Ravitz (1997) notes that the assessment of social interactions that occur online must use ethnographic approaches such as discourse analysis of messages that tell more about the interactions that occurred. He focuses attention on the importance of assessing questions such as 'How did the interactions change the participants?' and proposes one methodology described as the Interactive Project Vita.

The following section describes the development of an interaction analysis model by the author and her colleagues for examining the social construction of knowledge in group-based computer conferencing (Gunawardena, Lowe, and Anderson, 1997).

AN INTERACTION ANALYSIS MODEL FOR EXAMINING SOCIAL CONSTRUCTION OF KNOWLEDGE

The study undertaken by Gunawardena, Lowe, and Anderson, (1997) was interested in finding appropriate interaction analysis techniques that help address the following two evaluation research questions:

1. Was knowledge constructed within the group by means of the exchanges among participants? And

2. Did individual participants change their understanding or create new personal constructions of knowledge as a result of interactions within the group?

They examine the definition of 'interaction' in a computer-mediated communication (CMC) environment, explore strengths and shortcomings of currently available interaction analysis techniques, and propose a model based on grounded theory building for analyzing the quality of CMC interactions and learning experiences. The interaction analysis model was developed by analyzing the interactions that occurred in a professional development exercise; the ICDE95 global online debate conducted through asynchronous computer conferencing. The authors contend that the debate forms a particularly good example of collaborative construction of knowledge through social negotiation, a key feature of a constructivist learning environment. Fortunately, the computer provides a transcript that enables discourse analysis or interaction analysis.

In order to address the research questions posed above, a number of interaction analysis models were examined, and Henri's (1992) model selected as the most promising starting point. Three dimensions of this model, the interactive, cognitive, and metacognitive, were selected as a framework for detailed analysis of the debate. However, it became clear that three aspects of Henri's (1992) model; its basis in a teacher-centered instructional paradigm, its distinction between the cognitive and the metacognitive dimensions, and its treatment of the concept of interaction, were unsuited for application to the debate. The authors therefore, developed a framework of interaction analysis that would be more appropriate for analyzing the debate transcript.

Gunawardena, Lowe and Anderson (1997) believe that the metaphor of a patchwork quilt better describes the process of shared construction of knowledge that occurs in a constructivist learning environment. A quilt block is built up by the application, one after another, of small pieces of cloth, which when assembled form a bright and colorful pattern. The pieces, according to this analogy, are the contributions of individual participants. Each participant contributes to the whole his or her own texture and color of thought, just as every scrap of fabric forms a distinctive element in the overall pattern. The pattern may not be complete during a single conference, but individual responses can contribute toward the formation of a pattern. The process by which the contributions are fitted together is interaction, broadly understood, and the pattern which emerges at the end, when the entire gestalt of accumulated interaction is viewed, is the newly-created knowledge or meaning. Interaction is the essential process of putting together the pieces in the co-creation of knowledge.

Based on this new definition of interaction, the debate was analyzed for the: 1) type of cognitive activity performed by participants (questioning, clarifying, negotiating, synthesizing, etc.), 2) types of arguments advanced throughout the debate, 3) resources brought in by participants for use in exploring their differences and negotiating new meanings, and 4) evidence of changes in understanding or the creation of new personal constructions of knowledge as a result of interactions within the group.

Grounded on this analysis an outline was developed of the process of negotiation which appears to occur in the co-construction of knowledge. The outline led to the development of the model which has five phases, reflecting the complete process of negotiation which must occur when there are substantial areas of inconsistency or disagreement to be resolved. The phases of learning outlined in this model occur at both the individual and social level and can be described as:
Phase I: Sharing/Comparing,
Phase II: Dissonance,
Phase III: Negotiation/Co-construction,
Phase IV: Testing Tentative Constructions, and
Phase V: Statement/Application of Newly-Constructed Knowledge.

In applying the model to the analysis of the debate it was evident that the debate format influenced the process of co-construction by sometimes supporting and sometimes hindering the efforts made by participants to reach a synthesis, a Phase III operation. The debate format supported Phase I by soliciting agreement on propositions, and Phase II by introducing inconsistencies between statements and helped to move the arguments to Phase III. However, the debate format hindered the desire of participants to reach a compromise or a synthesis at Phase III and above, as the debate leaders tried to keep the two sides apart.

Two major themes were observed. One was the progress of certain strands of argument from Phase I to Phase V which can be described as an exercise in the co-construction of knowledge, moving from lower to higher mental functions. The other was the evidence of more than one and sometimes three phases within a single message posted by one participant, which usually progressed in sequence through the phases, showing progress from lower to higher mental functions, showing how individuals contributed toward the co-construction. Detailed discussion of the application of the model to the analysis of the debate is found in Gunawardena, Lowe, and Anderson (1997). The efficacy of the interaction analysis model described above was tested in a second online forum (Anderson & Kanuka, 1998).

This paper has discussed the issues that web-designers must consider as they approach designing interaction that facilitates the teaching - learning process. It has also discussed issues that evaluators must consider as they begin to evaluate the learning that occurred as a result of that interaction. The paper has provided models for designing interaction and for evaluating the social construction of knowledge in web-based distance education.

References:

Anderson, T. & Kanuka, H. (1998). Evaluating the workplace center on-line forum: Knowledge construction and learningcommunities. Unpublished research report. Office of the Learning Technologies, Human Resources Development Canada, Ottawa, Canada.

Boshier, R., Mohapi, M., Moulton, G., Qayyum, A., Sadownik, L., & Wilson, M. (1997). Best and worst dressed web courses: Strutting into the 21st century in comfort and style, Distance Education, 18(2), 327-349.

Dinucci, D., Giudice, M., Stiles, L. (1998). Elements of web design. Berkeley, CA: Peachpit Press.

Gunawardena, C. N. (1998). Designing Collaborative Learning Environments Mediated by Computer Conferencing: Issues and Challenges in the Asian Socio-cultural Context. Indian Journal of Open Learning, 7(1), 105-124.

Gunawardena, C. N., & Zittle, F. (1997). Social presence as a predictor of satisfaction within a computer mediated conferencing environment.

American Journal of Distance Education, 11(3), 8-25.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. Journal of Educational Computing Research, 17(4), 395-429.

Gunawardena, C. N. (1995). Social presence theory and implications for interaction and collaborative learning in computer conferences. International Journal of Educational Telecommunications, 1(2/3), 147-166.

Henri, F. (1992). Computer conferencing and content analysis. In A. Kaye (ed.), Collaborative learning through computer conferencing: The Najaden papers (pp. 117-136). Berlin: Springer-Verlag.

Hillman, D. C., Willis, D. J., & Gunawardena, C. N. (1994). Learner-interface interaction in distance education: An extension of contemporary models and strategies for practitioners. The American Journal of Distance Education, 8(2), 30-42.

Hiltz, S. R. (1990). Evaluating the Virtual Classroom. In L.M. Harasim (ed.), Online Education, New York: Praeger.

Jonassen, D. H. (April, 1994). Thinking technology: Toward a Constructivist design model. Educational Technology, pp. 34-37.

Knowles, M. S. (1990). The adult learner: A neglected species, (4th ed.). Houston, Tx: Gulf Publishing.

Levin, J. A., Kim, H., & Riel, M. M. (1990). Analyzing instructional interactions on electronic message networks. In L. Harasim (Ed.), Online education (185-213). New York: Praeger.

Moore, M. G. (1989). Editorial: Three types of interaction. American Journal of Distance

Education, Vol. 3, No. 2, pp. 1-6.

Ravitz, J. (1997). Evaluating learning networks: A special challenge for web-based instruction, In B. H. Khan (Ed.), Web-based Instruction (361-368). Englewood Cliffs, NJ: Educational Technology Publications.

Linking the WWW and Relational Databases through Server APIs: a Distributed Approach

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Abstract: The impressive boost that the WWW has received have turned this platform to a very important candidate for the deployment of various kinds of applications in the Internet and in corporate intranets. An area where the WWW had considerable impact is that of DBMS applications. A distributed architecture for RDBMS gateways is presented. Such architecture is based on the Sockets mechanism which allows the client and server parts to operate on different platforms. The Microsoft ISAPI specification has been adopted for the gateway's interface towards the WWW server. Additionally, the gateway takes provision for the reduction of the rate at which connection rejections are experienced at the server part. This approach proves very assisting under periods of heavy workload as users obtain, at a very small time expense, the desired service with high probability. A proprietary protocol for the communication between the client and server parts is also introduced.

1. Introduction

Since its introduction, in the early '90s, the WWW has become the defacto standard for the deployment of telematic applications in wide area networks. Furthermore, WWW is adopted as the basic technology for the introduction of intranet applications. WWW greatly owes its success in the standardisation of the communication between WWW servers and browsers. The three open and well established standards which are involved in such communication are: the Universal Resource Identifiers (URI) addressing scheme, the HyperText Transfer Protocol (HTTP) and the HyperText Markup Language (HTML).

WWW servers carry specialised software, called HTTP demon (hereinafter to be referred to as httpd), which receives and dispatches HTTP requests issued by browsers. The need to incorporate information sources other than static HTML files (e.g., DBMSs, information retrieval systems) motivated the standardisation of the communication between httpds and legacy application programmes. Such efforts led to the specification of Common Gateway Interface (CGI) [Coar & Robinson 98] which is supported by all httpds. The CGI standard though, proves highly inefficient during periods of heavy workload. Throughout the evolution of the WWW, key industrial players like Netscape and Microsoft introduced their own, proprietary mechanisms (e.g., NSAPI, ISAPI) as enhanced and elaborated alternatives for performing similar tasks (i.e., dynamic generation of pages, extension of basic server's functionality). Such specifications are also the "building blocks" of contemporary server functionality extension frameworks like Microsoft's Active Server Pages (ASP).

RDBMS gateways (i.e., software for interfacing legacy RDBMSs to the WWW service) have always attracted the interest of the WWW community. Such connectivity has been a trendy research issue since the early stages of the service [Eichmann et al. 94], [Perrochon 95] while many relevant tools emerged in the software market. Issues-problems associated with the deployment of database gateways encompass: portability among systems, generality [Hadjiefthymiades & Martakos 96], compliance to standards, high performance [Hadjiefthymiades & Martakos 97], stateful operation, transaction support, etc.

In this paper we discuss issues associated with the development of a software prototype of a generic database gateway which is compliant with the Internet Server API (ISAPI) specification [Tracy 96]. Such gateway has a client/server architecture and thus, may operate in a distributed way.

The server part of the gateway (GSP: Gateway Server Part) is installed and operated in a database server, receives SQL statements through the BSD Sockets inter-process communication (IPC) mechanism, executes them on the designated database and returns the generated results' set back to the client part. The client part

(GCP: Gateway Client Part) operates within Microsoft's Internet Information Server as an ISAPI compliant dynamic link library (DLL). Its principal role covers the formulation of SQL statements on the basis of input transmitted to the httpd by the interacting browser, composition of messages intended for the GSP, retrieval or the respective responses and transmission of results back to the browser.

Our intent is to find solutions for eliminating problems in different intranet uses. Some of the technical issues faced hereinafter have been encountered during the development of intranet servers for tele-teaching [Metaxaki-Kossionides 97] where a significant volume of data needs to be provided to the user in very short time.

This paper is structured as follows. Section 2 presents the protocol designed for the interaction between the GSP and the GCP. Section 3 discusses the internal structure of the two modules in the software prototype. The GSP, due to the requirement for the execution of any SQL statement submitted by the GCP, is based on the X/Open compliant Dynamic SQL API that many of the contemporary RDBMSs offer (e.g., Informix, Oracle). The GCP has a multi-threaded structure but the execution of individual threads is controlled to avoid potential overflows in the Socket queue of the GSP. In Section 4 we present certain results from the pilot operation of the gateway. To evaluate the efficiency of the thread controlling mechanism we have tested the gateway prototype through a HTTP pinger program which simulates the traffic caused by a population of WWW users. We conclude this paper in Section 5 where we summarise the presented work.

2. Gateway Client - Server Interaction Protocol

One of the most crucial aspects of the architecture presented above is communication between the GSP and the GCP. The specification of such communication encompasses the design of a database oriented protocol as well as the selection of an IPC mechanism suitable for its implementation. The protocol is presented in the following paragraph while the selected IPC mechanism is BSD Sockets [Comer & Stevens 93].

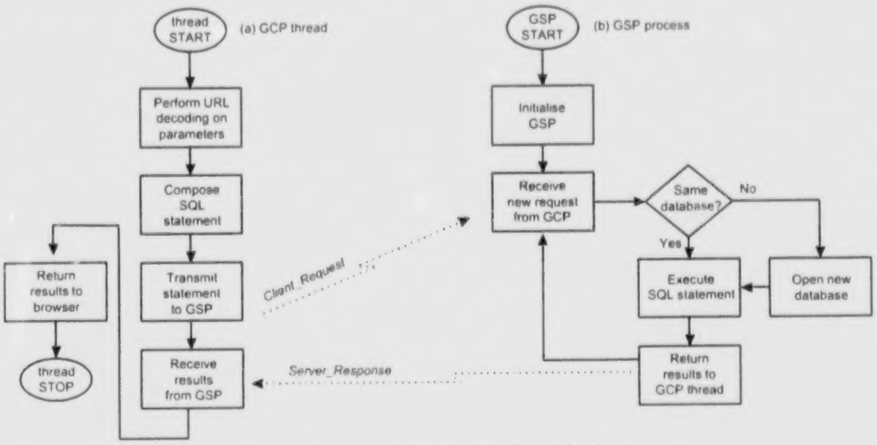
thread START
(a) GCP thread
Perform URL decoding on parameters
Compose SQL statement
Transmit statement to GSP
Receive results from GSP
Return results to browser
thread STOP
Client_Request
Server_Response
GSP START
(b) GSP process
Initialise GSP
Receive new request from GCP
Same database?
No
Yes
Execute SQL statement
Open new database
Return results to GCP thread

Figure 1: Flowcharts for GCP and GSP.

The protocol comprises two message structures; has the form of a typical request-response protocol. The first structure refers to requests transmitted by threads of the GCP. Such threads, as show in [Fig. 1], are responsible for URL decoding the activation parameters (contents of QUERY_STRING, name-value pairs, etc.), compose a request (*Client_Request*) intended for the GSP and proceed with its transmission. Such message indicates the database to be accessed, the SQL statement to be executed as well as the layout of the anticipated results (with respect to the HTML). In [Fig. 2] we provide the Backus-Naur Form (BNF) of *Client_Request*.

In [Fig. 2], **OCTET* denotes a sequence of printable characters and thus, represents a string field. Results are communicated back to the GCP threads by means of the second message of the protocol which will be referred to as *Server_Response*. The *Server_Response* is a plain byte stream (i.e., Server_Response = *OCTET)

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containing the results of the executed query. Such information is returned to the client, embedded in valid HTML commands. The type of commands used is the one specified in the *results_layout* field of *Client_Request*.

```
Client_Request = database_name + sql_statement + results_layout
database_name = *OCTET
sql_statement = *OCTET
results_layout = "TABLE" | "PRE" | "OPTION"
```

Figure 2: BNF of Client_Request.

3. Internal Structure of GSP and GCP

3.1 Gateway Server Part

The GSP is a standard UNIX demon process developed in conventional C and operated in a Sun Solaris workstation. Due to its generic orientation, GSP should be able to dispatch any SQL statement irrespective of the database-table and field combination it addresses. In this respect, query execution is realised through Dynamic SQL. Dynamic SQL allows applications to interact with database tables and fields without prior knowledge of their structure, data-types, length etc. [Date 95]. In our software prototype data retrieval was realised through the Dynamic SQL API of the Informix RDBMS [Informix 96] and more specifically, through the sqlda C structure (not standardised by X/Open but providing quite similar functionality). The use of Dynamic SQL, though, could undermine the performance of the proposed architecture. As the database management system needs to generate an access plan at runtime for Dynamic SQL statements, Dynamic SQL is generally slower than static SQL (static SQL is used when conventional Embedded SQL programs are built). To diminish the associated overhead, we have adopted an optimised form of Dynamic SQL execution, named *prepared* execution.

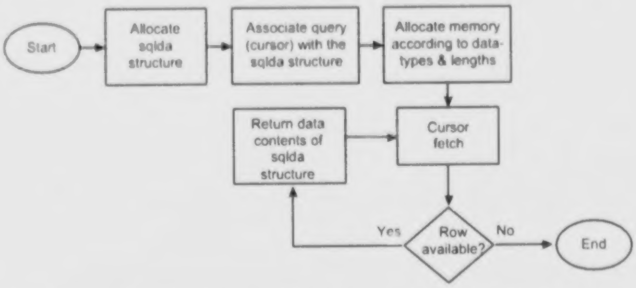
Start
Allocate sqlda structure
Associate query (cursor) with the sqlda structure
Allocate memory according to data-types & lengths
Return data contents of sqlda structure
Cursor fetch
Yes
Row available?
No
End

Figure 3: Information retrieval through the sqlda structure.

The sqlda structure indicates, similarly to the X/Open System Descriptor Area, the number of columns fetched as well as their particular characteristics (datatype, length, name, precision, scale, etc.). Furthermore, sqlda contains pointers to the actual data. As the database access through 3-GLs (i.e. C, COBOL) is cursor based, pointers to data are updated each time a new row is fetched by the system. In our case, the server process scans the overall sqlda after each invocation of the cursor FETCH command and prints its contents according to the *results_layout* field of the *Client_Request*. The dynamic mechanism for database access is presented in the flowchart of [Fig. 3]. The sqlda structure rendered our prototype capable of accessing any database table, without the need for hard-coded definitions, system tables lookup etc. In addition to the above, through the functionality of the DATABASE command (Embedded SQL) the prototype could access the whole range of available databases. Results are returned by the database agent in three different formats which are specified in the *results_layout* field of *Client_Request*. HTML Tables ("TABLE") and preformatted text ("PRE") are mainly used for the tabular presentation of query results. The "OPTION" alternative is used for the population of combo boxes intended for Query By Example (QBE) forms [Hadjiefthymiades & Martakos 96]. Regarding its

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communication with the GCP, the GSP behaves as an iterative connection oriented server [Comer & Stevens 93].

3.2 Gateway Client Part

As already discussed, the GCP was built as a dynamic link library (DLL) compliant with the ISAPI specification. ISAPI DLLs can be loaded and called by an HTTP server and provide similar functionality to CGI applications. The competitive advantage of ISAPI over CGI is that ISAPI code runs in the same address space as the httpd and has access to all the resources available to the httpd. Additionally, ISAPI extensions, due to their multi-threaded orientation, have lower overhead than CGI applications because they do not require the creation of additional processes upon reception of new requests and do not perform time-consuming communications across process boundaries. ISAPI DLLs may be unloaded if the memory is needed by another process. Interaction between the ISAPI extension code and the httpd is performed through a memory structure called Extension Control Block. Each request addressed to the ISAPI extension causes a new ECB to be instantiated and filled with information like the QUERY_STRING parameter encountered in common CGI applications.

In the prototype, the GCP consulted an external file where the mapping of databases to specific database servers (hosts) was held. Additionally, this external file contained the TCP port of the database server to which the GSP was bound and the GCP should address its *Client_Request* messages. [Fig. 4] presents the distributed operation of the gateway where one GCP is capable of relaying users' requests to multiple database servers. The TCP network can be the Internet, a LAN. Alternatively, the loopback interface of the WWW server machine could be used (Windows NT hosted RDBMS).

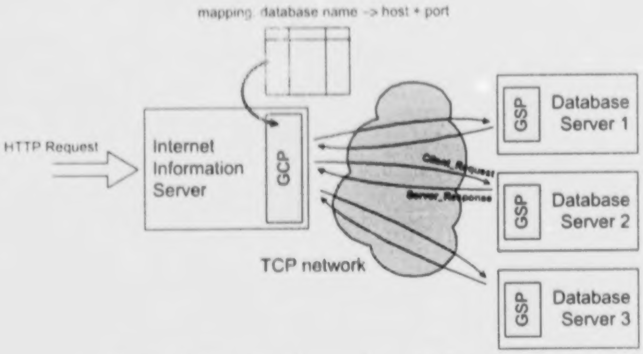

Figure 4: Distributed operation of the gateway.

For its communication with the GSP, the GCP uses the Windows Sockets (Winsock) library [Boner 96]. Although the Winsock interface supports the "Asynchronous notification", through which several Winsock primitives can be executed in non-blocking mode, we based the internal structure of the GCP on the blocking mode of operation (i.e., primitives like connect( ), accept( ), recv( ) and send( ) remain blocked until the respective network task is completed). The same model applies to the UNIX Socket interface.

One important issue that affects the design of the GCP is the possibility of excessive loads in the GSP which may result in connection rejections. When the size of the demon's incoming queue exceeds the specified maximum, new connections are dropped (more accurately, the TCP SYN packets - used in the 3-way handshake - are dropped). To cover this case and apply a pro-active strategy which could eliminate connection rejections, the GCP employs a Windows *semaphore* [Schildt 97]. Through this semaphore, the simultaneous operation of multiple requesting threads of the ISAPI extension can be controlled. The semaphore allows one or more threads to concurrently access a specific resource which in our case is the capability to issue a socket connection request towards the designated GSP. The maximum number of threads that can simultaneously gain access to the resource is specified in the CreateSemaphore( ) primitive. When the maximum number of threads allowed within the semaphore is reached, new threads, that try to obtain control of the resource remain blocked. The time, during which, new threads may remain blocked is controllable and may extend to infinity. The

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semaphore is released by a non-blocked thread as soon as the latter receives the Server_Response from the GSP. In our prototype, the maximum number of threads allowed to simultaneously communicate with the GSP is 6 while the maximum waiting time for a thread has been set to INFINITY, (i.e., all threads are eventually allowed to transmit).

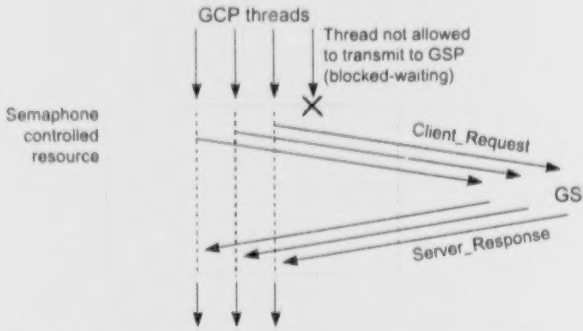
GCP threads
Thread not allowed to transmit to GSP (blocked-waiting)
Semaphone controlled resource
Client_Request
GSP
Server_Response

Figure 5: Semaphore controlled transmission of Client_Requests.

4. Gateway Performance Measurements at Increased Workload

A series of trials were performed to demonstrate that the connection rejection avoidance mechanism discussed in Section 3 substantially ameliorated the behaviour of the gateway. The relevant testbed consisted of two workstations connected through an Ethernet LAN. The LAN was isolated by other workstation to exclude unwanted traffic which could endanger the accuracy of our measurements.

From the two workstations the first was executing Windows NT while the second Solaris 2.5.1. In the Solaris workstation we have installed and configured an Informix Online Dynamic Server Ver. 7.1. Attached to the RDBMS was the GSP which was programmed in ANSI C and Embedded SQL. The Windows NT workstation was executing Microsoft's Internet Information Server (httpd) and the GCP. The latter module was programmed in MS-Visual C++ ver.5. Additionally, the Windows NT workstation was equipped with a HTTP pinger application capable of generating the traffic caused by a population of WWW users. The pinger application directed its requests to the httpd through the TCP loopback interface. This architecture is shown in [Fig. 6].

The pinger was configured to emulate the traffic caused by up to 10 simultaneous HTTP clients. Cumulative statistics were collected and recorded for each hypothetical HTTP client after the repetitive execution of 40 HTTP requests. Two series of trials were performed: one in which the connection rejection avoidance mechanism was not activated in the GCP and one in which the considered mechanism was brought into effect. In the former case, after the 6 users limit, we observed a considerable connection rejection rate. The percentage of successfully completed requests as a function of the HTTP population is plotted in [Fig. 7].

When the connection rejection avoidance mechanism was applied (i.e., the semaphore prevented multiple threads from simultaneously accessing the GSP), the total time required for the completion of experiments was increased. GCP threads incur an additional delay due to the fact that they are blocked waiting for the semaphore to be released by another thread which has already established communication with the GSP. Connection rejections in GSP are not experienced in this scenario. The additional time overhead is calculated at 2.7% and 2.1% for the 8 users and 10 users scenarios respectively (i.e., an HTTP user is guaranteed to provision of the service - database browsing - if he is willing to experience an additional time overhead in his queries for information; the mean value of this overhead is estimated at 2.1% for the 10 user workload).

5. Conclusions

In this paper we have presented the design and implementation of a client/server WWW-DBMS gateway. This gateway adopts the ISAPI specification for its interface towards the WWW server. Additionally, the gateway employs the BSD Sockets mechanism for the communication between its client and server parts. The BNF of a proprietary protocol introduced for the communication between these two components of the gateway has been presented. To reduce the connection rejection phenomenon at the server part of the architecture, throughout periods of heavy workload, the client part applies a pro-active strategy though the introduction of a semaphore structure. The benefits from the introduction of the semaphore has been quantified through a series of trials.

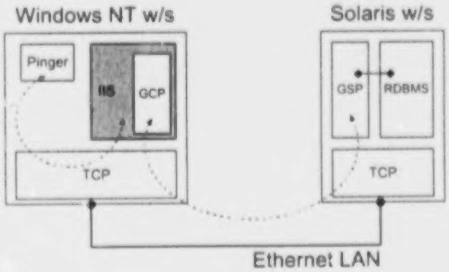

Figure 6: Test-bed.

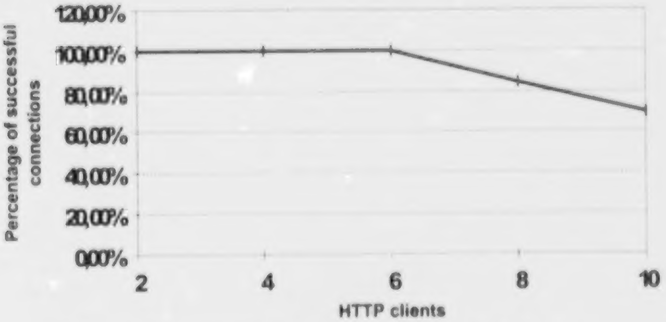

Figure 7: Percentage of successfully completed requests.

6. References

[Boner 96] Boner, P. (1996). *Network Programming with Windows Sockets*. Prentice-Hall Inc.

[Coar & Robinson 98] Coar, K.A.L. & Robinson, D. (1998). The WWW Common Gateway Interface Version 1.2. *Internet Draft*.

[Comer & Stevens 93] Comer, D. & Stevens, D. (1993). *Internetworking with TCP/IP Vol III: Client-Server Programming And Applications*. Prentice-Hall Inc

[Date 95] Date, C.J. (1995). *An Introduction to Database Systems*. Addison-Wesley.

[Eichmann et al. 94] Eichmann, D., McGregor, T. & Danley, D. (1994). Integrating Structured Databases Into the Web: The MORE System. *Computer Networks and ISDN Systems*, 27 (6).

[Hadjiefthymiades & Martakos 96] Hadjiefthymiades, S. & Martakos, D. (1996). A generic framework for the deployment of structured databases on the WWW. *Computer Networks and ISDN Systems*, 28 (7-11).

[Hadjiefthymiades & Martakos 97] Hadjiefthymiades, S. & Martakos, D. (1997). Improving the performance of CGI compliant database gateways. *Computer Networks and ISDN Systems*, 29 (8-13).

[Informix 96] Informix, (1996). *Informix-ESQL/C Programmer's Manual*. Informix Software Inc.

[Metaxaki-Kossionides 97] Metaxaki-Kossionides, Ch. (1997). A design Procedure for Training in Web. *WebNet, 1997*, Association for the Advancement of Computing in Education, Torondo, Canada.

[Perrochon 95] Perrochon, L. (1995). W3 Middleware: Notion and Concepts. *Workshop on Web Access to Legacy Data, WWW Conference 1995*, Boston, MA.

[Schildt 97] Schildt, H. (1997). *Windows NT4 Programming*. Osborne/McGraw Hill.

[Tracy 96] Tracy, M. (1996). *Professional Visual C++ ISAPI Programming*. WROX Press.

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Explorations - A New Form of Highly Interactive Learning Materials

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Abstract: The following contribution describes our present approach to the development of hypermedia materials for and by the help of students. The interactive JAVA learning and teaching environment *mechado* intents to illustrate the idea of developing a mixture of highly interactive animations and simulations, so called *explorations*. Explorations form a digital laboratory, which allows students to create, modify, calculate and describe complex problem settings in an interactive manner over the net. *Explorations* are more than common animations, since they give the student a most direct feedback and operate more as an interactive learning environment dealing with a special topic. As a second fact explorations do not only provide a constructive net-based workbench for students, but allow teachers to define tasks and respective constraints that have to be worked out by the students. Furthermore, explorations are means to structure the teaching materials, because they represent complex multimedia models which are centred around important themes and issues in the respective curriculum.

Introduction

On the one hand the rapidly growing number of conferences, books and articles dealing with computer-based concepts and methods for teaching and learning exemplify that new media may soon become a natural and integral part of all kinds of learning processes. On the other hand, the vast amount of publications shows that multimedia still has not reached this goal, because we are teaching about means and technologies to support learning rather than discussing what should be learnt and why. In our view two deficits have to be overcome:

Viability of every day use (Alltagspraxis) [see Brennecke & Keil-Slawik 1995]): Tools and infrastructures must be designed in such a way that they support the day to day activities of students and lecturers and ease their burden rather than demonstrate outstanding and unparalleled single accomplishments.

Electrification of the Nuremberg Funnel (Nürnberger Trichter): Multimedia and networking should be used to enhance the lecturers ability to communicate what they have learnt and to decide how to accomplish their teaching goals rather than increasing the lecturers means to control the learning process by supporting them with an ever more refined mechanism for instructional design [see Brennecke et al. 1997].

Both deficits are by and large caused by an engineer's exclusive concern to only demonstrate the flexibility of a new innovative technological idea (what Ted Nelson coined cybercrud), and an pedagogue's continuous attempt to control the uncontrollable, the self-organising process of learning. Finally economists' attempt to cut down costs by replacing expensive labour processes by way of using multimedia technology.

In contrast to a technology centred approach, we have set up during the last 5-6 years an infrastructure for computer supported cooperative learning, which allows us to study the production of teaching material and its use under the constraints of routine teaching in a university.

Everyday viability by setting up a complex learning environment comprising networking and special server technology, electronic course materials, multimedia laboratories, new concepts of teaching as well as especially designed furniture is our innovation [see Keil-Slawik & Selke 1998].

Everyday viability, however, is not restricted to the configuration and adaptation of existing tools and technology, but it includes the development of innovative technology as well. The only difference is that the design of such projects is not primarily based on an analysis of what can be sold in terms of innovative contributions to a specific scientific community and what might be applicable in a couple of years from now. It is rather based on an analysis of today's pitfalls and shortcomings and an assessment of what can be integrated in today's infrastructure to create a sustainable learning environment.

To avoid misunderstandings, we would like to add that this is not a question of innovation versus every day viability – we need both. The point is that integrating both is not just a matter of developing and applying technology at different instances of time. Many facts of this integration require intertwined activities of design, use and evaluation where sometimes only hard demands and requirements of every day teaching and learning activities (situated actions) provide the necessary feedback needed to decide which mixture of technological and non-technological means will finally lead to a sustainable learning environment.

Our entire approach to learning, our education and character are geared more and more towards active participation in the learning process. Students write their own texts in school from their first year on, in mathematics problems must be solved independently for a deeper understanding which results in the creation of new problems to be discussed. Modern didactical concepts aim at a self-exploring process of learning. Therefore, the students should be enabled to develop new knowledge independently and "learn how to learn". They should be encouraged to discover and solve problems in their everyday environment on their own. Following this philosophy, learning is not simply the transfer of materials into the students heads. Rather it is the art to awake an interest and to simplify and to illustrate the acquisition and compilation of knowledge in new ways. To this end the objective of new media is to develop an active and open organisation of knowledge transfer. Multimedia cannot be a high-tech solution for the old problem of transferring knowledge as easily as possible from books or from the head of the instructor into the head of the learner.

Our metaphor of "the quarry of learning" [see Keil-Slawik 1998] describes learning with the support of multimedia as a collection of most different aspects and styles. Each student breaks his personally relevant "stone" from this "quarry", i.e., he/she learns individually. We see the realisation of this idea of the "quarry of learning" in the development of most different representations of knowledge by hypermedia working environments and multimedia databases. The main target is to provide the students with a surrounding that makes perceptive and active learning possible. The stimulation and the willingness to experiment with objects, to try them and to explore them in a playful manner will lead to active interaction and to the discovery of teaching subjects. Learners should understand and commentate texts, diagrams, animations and visualisations in hypermedia working environments and relate them to each other. Personal structuring, processing and compression of contents permits new forms of compilation of contents, particularly in a group.

Explorations, The Next Dimension of Learning

The integration of new media in engineering education and the "in-field test" of advanced future learning and training concepts can be characterised as the main interest of the project *mechANIma*[1]. The didactical concept as well as the underlying theory of the establishment of learning supportive infrastructures and the everyday practice of hypermedia configuration has already been described in details in a number of publications. Specific implementation concepts of the project *mechANIma*, the editing of basic mechanical problem representations, the development of interactive animations and visualisations has already been documented in detail at different conferences.[2] The present paper intents to illustrate the idea of developing a mixture of highly interactive animations and simulations, so called *explorations*. The main goal of such *explorations*, as realised in one early example, the statics tool *mechado*, are their possibilities to explore certain facts and to interact individually with the system. *Explorations* are more than common animations, since they give the student a most direct feedback and operate more as a interactive learning environment dealing with a special topic.

Another important feature of *mechado* is the fact, that it was developed by one of our students at the University of Paderborn, Michael Rüther. This supports our idea of an engineering student who is able to create his own sophisticated multimedia applications by the help of an adequate mixture of powerful and easy to use tools and applications.

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[1] The acronym *mechANIma* symbolises a synthesis of the terms mechanics and animation. The idea of introducing multimedia to form everyday teaching practice characterises the endeavour to integrate all audio-visual media like lecture records, lectures, instructional films, simulations and animations into a data base oriented hypermedia system for information and documentation. Main focus of the mechANIma project is the development of the necessary infrastructure and a pedagogic concept for a meaningful use of new media teaching. The *mechANIma* project is an interdisciplinary cooperation between the Laboratory for Technical Mechanics, and the Working Group Computers and Society at Paderborn University.

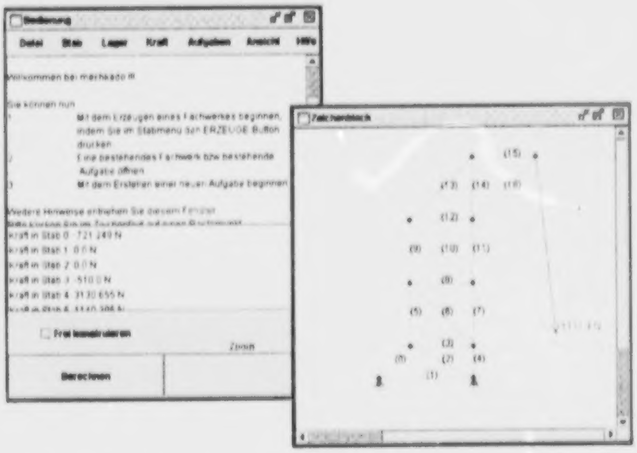
[2] See [Ferber et al. 1996], [Hampel & Ferber 1998], [Hampel et al. 1998a], [Hampel & Keil-Slawik 1998] and [Hampel et al. 1998b]

The Need for Explorations- *mechado*

One of the subjects of technical mechanics is statics, i.e., mechanical systems, such as bridges or cranes, which are loaded by forces and yet stay at rest [see Pestel 1989], [Gross et al. 1990], [Assmann 1993]. From the viewpoint of engineering science these systems play an extremely important role. It is the art of engineering to describe real objects, such as bridges and cranes, from a more abstract point of view and not necessarily consider every detail, but all the essential mechanical features. Especially components, which have a relatively simple structure and can be simplified to meet the features of a truss system are of interest. Bridges, cranes or scaffolds are suitable examples for such systems.

Despite the simplicity of the concept of a truss system the calculation of its internal forces and its reaction forces usually requires a substantial amount of algebraic manipulation as well as calculation time. The calculation of the example shown in [Figure 1] would require the solution of a system of equations with 18 unknowns. Since a by-hand calculation is very time-consuming, students cannot experience creative learning by changing and developing the best design for the crane possible. In this case common teaching methods fail, because there is no room for "creative play" with this type of problem. Realising this, the interactive framework-simulation of *mechado* was developed. The individual generation of frameworks with *mechado* particularly allows a creative design study. The editor offers the possibility to generate a framework step by step. Bars can be separately sketched, bearings and loads can be placed at various positions of the framework. During the interactive creation process of the crane the students get a good insight into the features of a truss system in general and will find answers to questions, such as:

- How does a framework react if the bearings or loads are changed?
- How does a framework react if bars are deleted or added?
- How have the bearings to be rearranged, so that the framework is stable?
- Which bars are free of forces?



Willkommen bei mechado !!!

Sie können nun
1) Mit dem Erzeugen eines Fachwerkes beginnen, indem Sie im Stabmenu den ERZEUGE Button drücken
2) Eine bestehendes Fachwerk bzw bestehende Aufgabe öffnen
3) Mit dem Erstellen einer neuen Aufgabe beginnen

Weitere Hinweise erhalten Sie diesem Fenster

Kraft in Stab 0: -721.249 N
Kraft in Stab 1: 0.0 N
Kraft in Stab 2: 0.0 N
Kraft in Stab 3: -510.0 N
Kraft in Stab 4: 3130.655 N

Figure 1: Example of a framework, which was created and solved in *mechado*.

The Development of *mechado*

The definition of fundamental elements and features of a truss system simulation was a necessary pre-requisite before implementing it in a programming language. In *mechado* simple truss systems can be created, to which many engineering problems can be reduced. Simple truss systems have to meet the following requirements:

- The bars of the truss are connected in central joints ignoring friction.
- Loads are to be applied to the system only at the joints. The forces in each bar are assumed to be either tensile or compressive in nature.
- The bars of the framework are straight-line structural elements.
- Single or double valued bearings are applied suitably which ensure static equilibrium of the truss system.

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- For simple frameworks the connection of bars has to be reproduced by the following rule: Start with a triangle of bars and extend it by adding two new members which intersect in a new joints until all bars and joints are used up.

Besides the interactive construction of frameworks with the above mentioned characteristics the creation and solution of problems is a further key feature of *mechado*. With the assistance of this functionality *mechado* is particularly useful in first and second year lectures which deal with the subject of statics. Some valuable teaching assistance is easily implemented [Figure 1].

The software package VisualAge for Java from IBM was chosen as the development environment for the first version of *mechado*. Due to the usage of the VisualAge package it was possible to create a large part of the user-interface by visual programming.

Besides its object-oriented approach, Java is the dominating programming language for applications in the internet. Thus, *mechado* can easily be started out of the internet and offers the opportunity to provide a wide range of users with the program.

Creation Of a Problem Example With *mechado*

A fresh start of *mechado* will result in a divided user-interface. The first window shows the drawing surface [see Figure 2] and the second window depicts all menus and text fields [see Figure 3]. If a menu point is selected, additional information will be displayed in the information field. Consequently, further explanations of each of the menu points is superfluous.

The important feature of *mechado* is the solution of truss frame problems which will be described next. In principle only two types need to be distinguished. The first type of problem consists of only one task, the student herself/himself has to generate the solution to a given problem. The second type of problem contains two tasks, the creation of a truss system as well as its numerical evaluation.

Creation of a Problem

After clicking *Start* in the menu *Erzeuge Aufgabenstellung (generate problem)* a truss system can be created which starts in the menu *Aufgabe (problem)*. The mode for drawing the truss members is activated by clicking on *Erzeugen (generate)* in the menu *Stab (member)*. If required, bearings and loads are applied to the framework (Fig. 6).

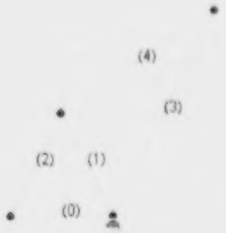

Figure 2: Example of a framework for a task.

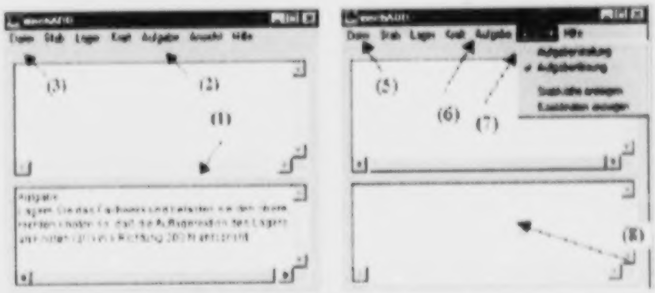

Figure 3: User-interface of *mechado*

Afterwards the description of the task can be typed in the text area [Figure 3(1)]. When the task is done, the menu item *Aufgabenstellung beenden (finish problem)* in the menu *Aufgabe (problem)* is selected [Figure 3 (2)]. The so far generated problem is saved by clicking on *Fachwerk (truss system)* in the menu *Spreichern (save)* [Figure 3 (3)]. After this step a problem has been created which only contains one task.

Generation of a Solution to a Problem

After a task has been created the solution to the task can be started immediately. Alternatively a file with an existing task must be opened. This is done by clicking on *Aufgabe (problem)* in the menu *Öffnen (open)* [Figure 3 (5)]. The generation of the solution is started by activating the menu item *Erzeuge Aufgabenlösung (generate problem solution)* in the menu *Aufgabe (problem)* [Figure 3 (6)]. The menu *Ansicht (view)* renders it possible to switch between the actual state of the solution and the task by clicking on the items *Aufgabenstellung (problem)* and *Aufgabenlösung (solution of the problem)* respectively [Figure 3 (7)]. Supplementary text for the solution may be typed in the text area [Figure 3 (8)].

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If the solution to the task is completed as required, the forces of the framework will be calculated by clicking on the button *Berechne (compute)*. After the computation the forces in each bar becomes apparent through colouring.

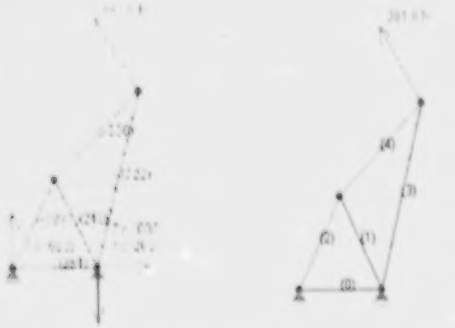
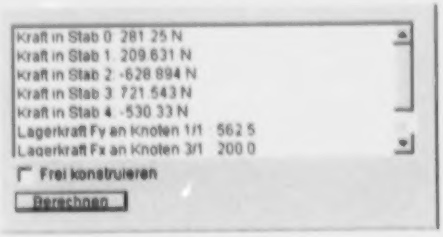


Figure 4: Different views on a calculated framework.



```
Kraft in Stab 0: 281.25 N
Kraft in Stab 1: 209.631 N
Kraft in Stab 2: -628.894 N
Kraft in Stab 3: 721.543 N
Kraft in Stab 4: -530.33 N
Lagerkraft Fy an Knoten 1/1 : 562.5
Lagerkraft Fx an Knoten 3/1 : 200.0
```

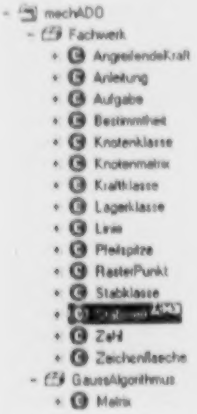
Figure 5: Output of the calculation for the internal and reaction forces.

Blue coloured bars indicate tensile forces, red coloured bars are loaded by compressive forces. Green bars are so called null bars, i.e., they are not loaded at all. By clicking on *Stabkräfte anzeigen (display forces)* in the menu *Ansicht (view)* it is possible to show the result of the calculated forces directly at the members in the drawing plane [Figure 4]. The internal forces of the bars and the reaction forces can also be read into the output window of the calculation. When the final solution to the task is found, the generation of the solution is finished by clicking on *Ende (end)* in the menu *Erzeuge Aufgabenlösung (generate solution)*. The whole problem can be saved by selecting *Aufgabe (problem)* in the menu *Speichern (save)*.

Class Structure in *mechado*

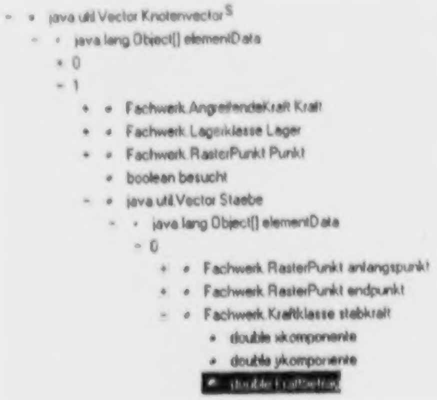
Classes, meaning independent program segments, are important components of object-oriented programming. The following classes can be found in *mechado* [Figure 6]. The development of classes, which obtain data and methods for the specification of objects, can very simply be handled in Java and clearly reflects the object-oriented approach. The features of the desired objects, which should be represented in the class, simply have to be defined and transformed. For example Objects of the type "member" have the following characteristics:

- a beam member has a start and end point as well as a number,
- a member has one internal force,
- the geometric position of the member is determined by the angle to the horizontal, the gradient, and its x- and its y-position, respectively.



```
- mechADO
  - Fachwerk
    + AngreifendeKraft
    + Anleitung
    + Aufgabe
    + Bestimmtheit
    + Knotenklasse
    + Knotenmatrix
    + Kraftklasse
    + Lagerklasse
    + Linie
    + Pfeilspitze
    + RasterPunkt
    + Stabklasse
    + [illegible]
    + Zahl
    + Zeichenflaeche
  - GaussAlgorithmus
    + Matrix
```

Figure 6: Class structure of *mechado*



```
- • java.util.Vector Knotenvector S
  - • java.lang.Object[] elementData
    + 0
    - 1
      + • Fachwerk.AngreifendeKraft Kraft
      + • Fachwerk.Lagerklasse Lager
      + • Fachwerk.RasterPunkt Punkt
        • boolean besucht
      - • java.util.Vector Staebe
        - • java.lang.Object[] elementData
          - 0
            + • Fachwerk.RasterPunkt anfangspunkt
            + • Fachwerk.RasterPunkt endpunkt
            - • Fachwerk.Kraftklasse stabkraft
                • double xkomponente
                • double ykomponente
                • double Kraftbetrag
```

Figure 7: Detail of the *Knotenvector* in the debugger.

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Objects of the type "bearing" are clearly defined by their position, the bearing coordinates, the type of bearing and the forces it is required to hold. Objects of the type "force" are defined by their magnitude and the x- and y-components of the force.
The above listed detail of the VisualAge debugger makes the object-oriented approach quite clear [Figure 7]. In the vector "nodevector" (*Knotenvektor*), which contains all joints of the actual truss system, all features for each joint can be found: an applied load, a bearing, the position of the joint as well as all bars that are added to the joint.

Conclusions

By creating explorations like *mechado* we will not try to compete with advanced technological solutions for single purposes. The notion of "Alltagspraxis" - "every day practise" that provides the necessary background for the integration of different tools and environments into a sustainable infrastructure is a research goal on its own. It is not sufficient that technology works in principle, but it must work on a day to day basis. Accordingly *mechado* and other explorations are evaluated by our students at the moment. We hope that these studies will support our idea of students getting a better insight and deeper understanding of mechanics by the constructive view on statics presented by *mechado* and other *explorations*.

References

[Assmann 1993] Assmann, B. (1993). *Technische Mechanik*, Band 1, 1993, Oldenbourg Verlag, München.

[Brennecke et al. 1997] Brennecke, A., Engbring, D., Keil-Slawik, R., Selke, H. (1997). *Das Lehren mit elektronischen Medien lernen – Erfahrungen, Probleme und Perspektiven bei multimediagestütztem Lehren und Lernen*. In: Wirtschaftsinformatik 39 (6), 563-568, 1997.

[Brennecke & Keil-Slawik 1995] Brennecke, A., Keil-Slawik, R. (1995). *Notes on the "Alltagspraxis" of Hypermedia Design*. In: H. Maurer (ed.) Educational Multimedia and Hypermedia, Proceedings of ED-MEDIA 95. Charlottesville (Va.): Association for the Advancement of Computing in Education 1995, pp. 115-120.

[Ferber 1996] Ferber, F.; Herrmann, K.P., Hampel, T. (1996). *Einsatz von Multimedia in der experimentellen Spannungsanalyse am Beispiel bruchmechanischer Untersuchungen mittels der Schatten- und Spannungsoptik*; GESA-Symposium, 10.-11. Oktober 1996, Schliersee.

[Gross et al. 1990] Gross, D.; Hauger, W.; Schnell, W. (1990). *Technische Mechanik*, Band 1: Statik, 1990, Springer-Verlag, Heidelberg.

[Hampel & Ferber 1998] Hampel, T.; Ferber F. (1998). *MechANIma – ganzheitliche Sicht auf neue Medien in der Mechaniklehre*; In: Tagungsband GI-Tagung Informatik und Ausbildung, 30. März - 1. April 1998 Universität Stuttgart, Springer- Verlag, Heidelberg.

[Hampel et al. 1998a] Hampel, T.; Ferber, F.; Müller, W. (1998). *mechANIma- New Didactic Concepts, Visualisations and Arrangements For The Teaching Of Mechanics*; In: Ottmann, T., Tomek, I., Proceedings of ED-MEDIA / ED-TELECOM 98. Freiburg, Germany: Association for the Advancement of Computing in Education 1998 (Vol.I), pp.458-465.

[Hampel & Keil-Slawik 1998] Hampel, T.; Keil-Slawik, R. (1998). *Interaktive Animationen und Visualisierungen, eine neue Qualität und „Spielwiese" für die Mechanik – Ergebnisse der interdisziplinären Projektgruppe ChiLis*. Java Informationstage 1998 (JIT), Frankfurt.

[Hampel et al. 1998b] Hampel, T.; Keil-Slawik, R.; Ferber, F.; Müller, W. (1998). *Hypermedia-teaching of mechanics-mechANIma; 3^{rd} Annual Conference on Integrating Technology into Computer Science Education* -ITiCSE '98 18^{th} - 21st August 1998, Dublin, Ireland.

[Keil-Slawik 1997] Keil-Slawik, R. (1997). *Multimedia in der Hochschullehre*. In: Simon, H. (ed.): Virtueller Campus: Forschung und Entwicklung für neues Lehren und Lernen. Münster New York München Berlin: Waxmann 1997, pp.27-42.

[Keil-Slawik 1998] Keil-Slawik, R. (1998). *Multimedia als Steinbruch des Lernens*. In: M. Hauff (Hrsg.): media@uni-multi.media? Entwicklung - Gestaltung – Evaluation neuer Medien. Münster New York München Berlin: Waxmann 1998, S. 81-99.

[Keil-Slawik & Selke 1998] Keil-Slawik, R., Selke, H. (1998). *Forschungsstand und Forschungsperspektiven zum virtuellen Lernen von Erwachsenen*. In: Arbeitsgemeinschaft Qualifikations-Entwicklungs-Management Berlin (Hrsg.): Kompetenzentwicklung '98 – Forschungsstand und Forschungsperspektiven. Münster: Waxmann 1998, S. 165-208.

[Pestel 1989] Pestel, E. (1989). *Technische Mechanik*, Teil 1: Statik, 1989, B.I. Wissenschaftsverlag, Mannheim.

sTEAM -
Cooperation and Structuring Information in a Team

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Abstract: Setting up infrastructures for computer-supported cooperative learning requires an integrated design approach which covers a range of different aspects, such as networks, servers, teaching concepts and tools. Cooperation is an integral part of the learning process and not just the complement to individual learning. Learning requires the flexible combination of the cooperative and the individual as well as synchronous and asynchronous activities. The research project "sTEAM" (Structuring Information in a Team) combines the experiences of our research group in the field of learning supportive infrastructures, with novel technological concepts to explore new ways of computer-supported cooperative learning through virtual environments. The aim of sTEAM is to allow groups of students and lecturers to construct and organise their individual and co-operative learning space. Both teachers and students should actively participate in the process of building knowledge. Students assemble in virtual rooms and rearrange the semantic structure of the learning room by simply moving or exchanging documents while communicating with each other. The sTEAM system consists of a highly efficient object-oriented sTEAM-server, connected to a database and flexible Java-clients. The server is event-driven and manages all user-objects as well as the communication between the connected clients. Clients are flexible Java components that adapt easily to individual needs. One important feature of the sTEAM system is that users are able to program objects during run-time.

Introduction

The Paderborn "DISCO" (Digital Infrastructure for Computer-Supported Cooperative Learning) is an elaborate multimedia environment for teaching and learning. It comprises of interactive teaching theatres (see [Norman 1990] and [Shneiderman 1993]), production facilities for multimedia documents, work places, and different kinds of networks, servers and software tools.

Setting up the DISCO was a combined effort of several research groups from five departments, under the guidance of our research group. One of our primary research goals is to evaluate the everyday viability (Alltagstauglichkeit) of multimedia-based learning environments (see [Brennecke, Schwolle, Selke 1997], [Brennecke & Keil-Slawik 1997] and [Brennecke & Keil-Slawik 1995]) and to provide a platform for exploring new ways of teaching and learning. Thus, the "Interactive Teaching Theatre" supports many-to-many communication replacing the traditional one-to-many, in-silence communication.

Networked personal computers supported by an interactive control panel enable students to be the sender as well as the receiver, the speaker as well as the listener, and the presenter as well as the viewer. Interaction takes place between people and not between computer and human. In order to accomplish this, new furniture even had to be designed to allow us to work in the most flexible way, with or without technology.

Together, special web server technology (sTEAM and Hyperwave, see [Andrews et al. 1995]) as well as additional self-developed cooperative tools, provide means for creating, accessing, annotating, and maintaining multimedia documents wherever and whenever learning takes place. In turn, we are able to conduct lectures fully via the Internet and evaluate the trade-off between the increase in resources needed and the effectiveness and quality of the teaching and learning process. This gives rise to the development of new concepts and methods, and the exploration of their viability under the constrains of day-to-day teaching and learning activities. As a result, we are able to specify requirements for setting up a sustainable multimedia infrastructure.

This infrastructure contains components relating to software as well as hardware. In particular, the connection and the variety of tools available to individually design teaching materials, text and graphics; as well as the cooperation and network tools applied at the working environment and other learning environments, give new inspiration to the ways of modern teaching. Particularly the connection of tools, such as CSCW systems that are equipped with learning supportive infrastructures, that support cooperative activities, are a healthy and fruitful mixture. In this sense, we do not so much intend to envision learning suggestive infrastructures as an independent set up or institution, but rather as being a necessary requirement for everyday use of new media in teaching. The idea of sTEAM is based on the fact that students need to create their own entry points to, and paths through, the material as part of their learning process; rather than follow pre-defined paths only which will more likely lead to the what's known as "lost in hyperspace syndrome". However, today, students lack appropriate means to create their own access structures to the quarrel and use trails [see Bush 1945] as well as entry points as objects of cooperation.

"Why We Decided To Built sTEAM."

So far, a classical client-server architecture (Hyperwave) is used to manage all documents for three courses in our institute. Our experiences show that in daily teaching and learning practice, three main problems arise:

very flexible, but pre-defined document structure - In normal teaching practice students learn with the help of a, in a sense, static document structure defined and written by lecturers and teaching assistants. For the learner this hypertext structure allows different ways through the material by following various links in alternative orders. Hence the flexibility lies in the link structure. In most cases this link structure is relatively static, students only have the possibility to build their own structure through bookmark lists or private collections in the Hyperwave system [see Andrews et al. 1995].

The "lost in hyperspace" syndrome - When building quite a large document space, covering an entire lecture or even three quite different lectures, the possibility of the so called "lost in hyperspace" syndrome arises. Our experiences dealing with standard WWW-technology show that structuring a large amount of documents only through the link structure, without an underlying structuring philosophy, such as the room or folder metaphor [see Henderson & Card 1985], is nearly impossible. When considering different types of learners it is considerably impracticable to guide each user through the document space. The danger and frequently the result is a loss of orientation in the linkage structure of the documents. Even from the point of view of a lecturer or author of document structures, the complex problem of maintenance and restructuring often leaves them feeling disoriented and confused.

no combination of productive and communicative facilities without discontinuities in the use of media - One field of our research is to evaluate the scientific interrelationship between information and communication technology and its usage context. Therefore, the main focus on the study of human learning processes, lies in the integration of new media and methods into the daily learning and teaching practice — particularly the integration of new media into present learning and group environments. Up until now, we have not found any hypermedia system which copes with this particular teaching environment. Common hypertext and multimedia systems are in most cases closed systems concerning the interaction of various learners with the learning materials. As a result, learners use different tools and media to communicate and work with the learning materials. We call this gap of integration and change between the media, out of technical reasons, *"discontinuities in the use of new media."*

Due to the aspects listed above there is an inherent lack of integration of communication supporting technologies and document structuring systems. For our particular teaching situation, it is significantly important to develop systems which support asynchronous as well as synchronous communication between the users, and allows one to structure documents and link the structures of the learning space individually as well as in groups.

sTEAM is our platform for the evaluation and research of new forms of human communication through virtual environments.

In consideration of existing products, we are not free to study the aspects of sociology and didactical concepts of learning. Meanwhile, it is possible to simply modify our own system. With this flexibility we may even consider studying the social structures of virtual learning communities in order to learn more about how students learn cooperatively [see Becker & Mark 1998]. Additionally, we are easily able to adapt and develop innovative user interfaces and add additional functionality needed for a specific experiment or course. Finding innovative design solutions for cooperative learning requires the evaluation of different approaches; for example, various forms of integration of the student's own work. A precondition of our supposition is the ability to easily design and implement special learning supportive infrastructures. The sTEAM system is designed to fulfil our particular needs in this area, concerning the flexibility to create prototypes and models quickly and to evaluate them with the help of our students under everyday learning and teaching conditions.

sTEAM Architecture

When commencing to describe the sTEAM architecture in detail, it is necessary to step back to the beginning of the history of the internet. With the emergence of local area networks and the massive growth of internet communication games on such networks, the so-called MUDs (multi-user dungeons), were developed.[1] While many of these were text-oriented, recent games of this type also support graphical user interfaces. MUDs are based on real-time communication and interaction of multiple users moving through a "virtual world" organised in "rooms" or "places". MUDs are based on a client-server architecture, allowing players with different computer systems to participate in these games from different places. On the one hand, MUDs are multi-user capable, on the other hand authorised players, the so-called wizards, can restrict access to the game. They are able to grant or deny a certain group of players access to specific "rooms" and are also able to extend the "world". In such games direct real-time communication and interaction are the main objectives. Groups of players can communicate directly and mutually influence each other in their game actions, as the communicational flow is unrestricted. Given that the architecture of MUDs is open, the games can be modified and adapted to new situations during the current session even while the system is running. Therefore, at any time during the game new situations could arise, which groups of players have to contend with.

In order to be able to modify MUD worlds in real time, it was necessary to develop very powerful interpreted object oriented script languages, e.g., the LPC language[2]. The idea to use this efficient architecture for non-game purposes is not new. A number of "serious" applications usually called "collaborative virtual environments" (CVE) - have been developed on top of the MUD architecture. By using techniques like MUD, IRC (Internet Relay Chat) or even newsgroups, social cohesion is supported or set up between users; a phenomena which is called "virtual community" [see Rheingold 1991], [Rheingold 1994].

Since our commencement in 1997, our goal has been to combine the advantages of both classical MUDs, and Hypermedia database systems, with each other, allowing users to share documents in a virtual world and to communicate with other users while working with certain documents [see Bollmeyer 1997]. The system developed is called sTEAM and uses the paradigm of virtual rooms to represent document space. People can meet in virtual rooms, interchange documents and communicate with each other. These forms of synchronised communication are particularly important when considering cooperative working conditions.

Similar to other approaches (e.g. [Huxor 1998], [Wessner et al. 1998]) the rooms can be seen as areas of interest or as given subjects of a lecture. We believe that the room metaphor [see Henderson & Card 1985], which is of course a directory metaphor, opens the gateway to serious research fields; namely, the question of awareness or presence. In these rooms (areas of interest) the stored objects are documents, all of which share a common topic or subject. Exits connecting different rooms represent hyperlinks. A prime advantage of this connecting technique is that hyperlinks represent a semantic context, without having to show a planar layout of the rooms illustrated by a planar map. We therefore believe the choice of a semantic oriented structure enables the user to create individual and powerful navigational concepts [Bush 1945], [Nelson 1980], [Klemme et al. 1998].

Among the system's main new features is it's ability to easily construct new rooms. As virtual rooms can be created by any user on-the-fly, document collections can easily be individually or collaboratively structured by the students. If students, for example, wanted to discuss different approaches to a certain topic during a tutorial or lecture, let's say, on user interface design, they could create a new room and meet there. They could then search for examples of different user interfaces on the web and collect them (as hyperlinks or as copies of the documents) in the new room. After they have finished their work, they could either leave this room and make it accessible for other students interested in the same topic, or just take a few objects back to their private rooms and delete the temporarily required room. With regard to the learning environment, the room, metaphorically speaking, gives rise to an interesting concept for structuring the learning process. Rooms may represent miscellaneous topics or different learning groups; at all times allowing groups of students to meet and work together on a specific topic. For every course there is one room designed to hand in one's exercises to the tutors. We are even considering the scenario of letting students mutually evaluate their exercises that are being presented in exercise and evaluation rooms.

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[1] Essex Computer Science graduates Richard Bartle and Roy Trubshaw wrote the world's first Multi- Dungeon (MUD) game when they were students at the University of Essex, U.K. the end of the 1970's.

[2] LPC is a small, object oriented type C language developed by Lars Pensjö for LP-MUD, a Multi-User Dungeon environment under many UNIX systems.

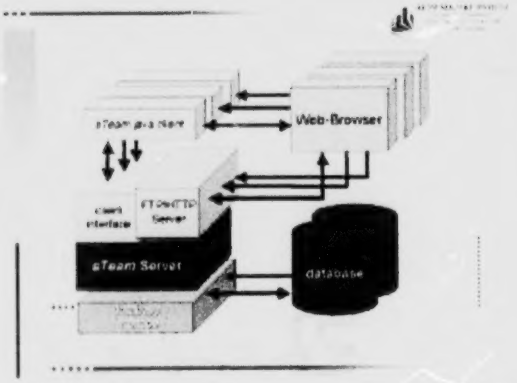

Figure 1: sTEAM architecture

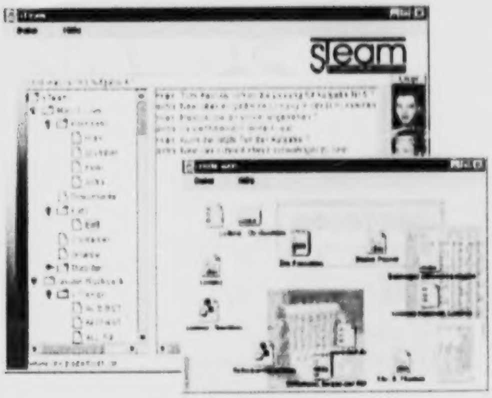

Figure 2: sTEAM client – prototype (design study)

Messages and attachments can be readily stored in such learning places and, most important, the learners would be able to meet in groups within the system. The system could either be used within a scenario where students meet "in real life", using the rooms in the way described, or within a scenario where students do not meet but rather make use of the integrated facilities that enable them to synchronously communicate with each other. Currently, only a text-based chat tool is integrated, however audio or video connections may be implemented in the future. Thus, collaboration is enhanced through a powerful CSCW-system regardless of whether people meet in the same place or work from different places.

We are currently in the process of developing a mechanism that creates, quick and easy, special robots that behave as autonomous tools or users in the sTEAM system. This technology allows us to create individual search engines, helping assistants and wizards to attach individual functionality to rooms or groups of users. Following the example above, users can create a guided tour through their materials or even a small helping assistant for new learners entering the respective learning space. Another potentiality is to create an open whiteboard for comments notices, etc., which are automatically posted to the author of the material, correcting their mistakes or to inform them of new proposals.

Groups of students and teachers can thus build and structure their individual and cooperative learning spaces. Students are given the possibility to actively participate in the process of constructing knowledge. Hypermedia documents can be transported easily between the various rooms. The underlying philosophy is that users meet in virtual rooms and rearrange the semantic structure of the learning room simply by using drag and drop, or exchange documents while communicating with each other — naturally using sTEAM.

The sTEAM system currently exists as a prototype, consisting of a client written in Java and a web server implemented in the MUDs own object-oriented programming-language LPC, using the Dworkins Generic Driver (DGD), a modified well-known MUD server [see Fig 1]. This system allows runtime modifications of all objects in the environment. Users can employ the predefined objects to create their individual environment inside of sTEAM, derive their objects from existing ones or create new ones by implementing them in LPC. As you would expect, many different new objects may be created over a long period of the system's use. Even though the predefined object-types are sufficient for our current needs, the creation of user-defined objects will be an essential key feature in the future of sTEAM. Setting up learning supportive infrastructures means adapting electronic media and communication to the specific environment and context of the learner, not to adapt the learner to the medium. Therefore, it is essential to design a technology which allows one to adapt the CSCL (Computer Supported Cooperative Learning) system, simply and frequently to the particular needs of the learner. By using sTEAM learners may create and modify individual objects of unique appearance and behaviour, allowing them to adapt their individual learning space within the system to their special requirements.

The sTEAM Server

All data management is currently covered by the sTEAM server; data-objects are stored in a MySQL database [see Axmark 1999]. By using an open JDBC/SQL-database interface still under development, it will be possible to connect sTEAM to various databases in the future; thus allowing the use of multimedia documents stored in a particular database or of hypermedia objects stored on a standard Web-Server or Hyperwave server. By these means, sTEAM can easily be integrated into existing web environments.

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All objects such as hypertexts, images, links, users, etc., have a number of common attributes that are used to control the objects details: such as name, access rights, owner, creation date, expiration date, etc., and its methods. In addition, some objects have special attributes and methods such as an associated MIME-Type with a download method for documents, or a method "talk to" for user objects. Users can also add their own generic attributes to objects. By default, the user object has a "virtual" container object, that is shown as a "suitcase" carried along by the user. Any objects intended to be taken along, even exits, can be stored in this suitcase and held there until being taken out.

sTEAM features a sophisticated security scheme resembling that of Hyperwave with one significant difference: User groups can be defined by any user, as they are just objects on the server which have attributes. Just the same as rooms, user groups can thus be created on-the-fly. Therefore, if any team of students decides to form a group which needs to share access rights, they can create a group object. (this concept is similar to the BSCW system see [see Hinrichs & Koch 1999], [Trevor & Koch 1997] or [Bentley & Appelt 1997].

Entry Point Into The Virtual Community -The sTEAM-Client

The client serves as the interface between the user and the functionality given by the server and thus has to be easy-to-use and platform independent. Due to this requirement it was implemented in Java. In order to create an easy-to-use interface in the current development [see Fig. 2], we restricted the view of the virtual environment to a simple 2D-representation. However, we are researching for an innovative 3D-representation of the document link structure or for the visualisation of elements of the room structure. We believe that 3D-representations may enhance the capability to display a large amount of nodes and documents or help learners to orientate themselves inside the document space. Interesting approaches are the adaptation of cone-trees or cam-trees and various similar concepts. (see [Robertson et al. 1993], [Young, 1996], or [Munzner 1998]).

Following this idea, we place great demands on the usability aspects of these representations and for them to run without the need of special virtual reality hardware, such as head mounded displays or eye trackers. The integration of these technologies would inhibit the flow of communication in group learning environments such as tutorials or lectures.

A brief description of our current sTEAM clients is as follows; the display presents three areas; one showing the users currently in the room; another showing the interior of the room, i.e., the objects including exits to other rooms; and the other the communication area. Here, the user is able to chat by typing text and talk or communicate in other text based ways.

All of these objects, even the users, are subject to direct manipulation. For instance, you can "talk to" other users, "download" documents, or move to other rooms with just a mouse click on the respective object. More sophisticated functions including the creation of new objects and file upload can be accessed by menus.

Conclusions

sTEAM is not our answer, but rather a new hypothesis embedded in teaching, allowing us to shape technology according to the needs of students and teachers. Thus sTEAM is used to study various concepts such as presence or awareness. Other interesting aspects are the sense of avatars [Damer 1998], or other concepts for 3D user interfaces such as special metaphors that visualise interaction patterns, etc. However, in doing so, our purpose is not to produce advanced technological solutions for single purposes. The notion of "Alltagspraxis", that provides the necessary background for the integration of different tools and environments into a sustainable infrastructure, is a research goal all on its own. It is not sufficient that technology works in principle, it must work on a day-to-day basis. Accordingly, DISCO as well as sTEAM are our approaches to supporting teaching and learning, but more important they are technological hypotheses which will help us to study the best way to support their processes in the future.

References

[Andrews et al. 1995] Andrews, K., Kappe, F., Maurer, H. (1995). *HyperG and Harmony: Towards the next generation of networked information technology*, CHI'95, Denver.

[Axmark et al. 1999] Axmark, D., Widenius M., DuBois, P., Aldale K. (1999). *MySQL Reference Manual*, http://www.mysql.com/doc.html

[Becker & Mark 1998] Becker, B., Mark, G. (1998). *Social Conventions in Collaborative Virtual Environments*, Snowdon, D. (Ed.), Churchill E. (Ed.): Proceedings of Collaborative Virtual Environments (CVE '98). Manchester , 1998, pp.47-55.

[Bentley & Appelt 1997] Bentley, R.; Appelt, W. (1997). *Designing a System for Cooperative Work on the World-Wide Web: Experiences with the BSCW System*, Nunamaker, J. F.; Sprague, R. H. (ed.): Proceedings of the HICCS '97, 30th Annual Hawai'i International Conference on System Sciences, Vol IV, January 7-10, 1997, Wailea, Hawaii.

Washington: IEEE Computer Society Press, 1997, pp. 297-306.

[Bollmeyer 1997] Bollmeyer, J. (1997). *HyperMUD*, ACM SIGGROUP Bulletin 18, No.1, pp.35–36.

[Brennecke & Keil-Slawik 1995] Brennecke, A., Keil-Slawik, R. (1995). *Notes on the "Alltagspraxis" of Hypermedia Design.*, Proc. of ED-MEDIA 95. Charlottesville (Va.): AACE 1995, 115-120.

[Brennecke & Keil-Slawik 1997] Brennecke, A., Keil-Slawik, R. (1997). *Einsatz elektronischer Lehr- und Lernumgebungen in der Software-Ergonomie Ausbildung.*, In: Liskowsky, R., Velichkovsky, B. M. und Wünschmann, W. (eds.): Software-Ergonomie '97 - Usability Engineering: *Integration von Mensch-Computer-Interaktion und Software-Entwicklung.* Stuttgart: Teubner 1997, pp.83-92.

[Brennecke et al. 1997] Brennecke, A., Schwolle, U., Selke, H. (1997). *The Evolution of an Electronic Teaching and Learning Environment.*, Müldner, T., Reeves, T. C.: Proceedings of ED-MEDIA / ED-TELECOM 97. Charlottesville (Va.): Association for the Advancement of Computing in Education 1997 (Vol.I), pp.98-105 Proceedings CD-ROM ED-MEDIA / ED-TELECOM 97, pp.196-203.

[Bush 1945] Bush, V. (1945). *As We May Think.*, Atlantic Monthly 176, No.1, pp.101–108.

[Damer 1998] Damer, B. (1998). *Avatars ! – Exploring and Building virtual worlds on the internet*, Peachpit Press, 1998

[Henderson & Card 1985] Henderson, A.J., and Card, S.A. (1985). *Rooms: The Use of Multiple Virtual Workspaces to Reduce Space Contention*, ACM Transactions on Graphics, Vol. 5, No 3, (July 1985), ACM Press

[Hinrichs & Koch 1999] Hinrichs, E., Koch, T. (1999). *Das BSCW Shared Workspace System*, GMD Spiegel 1/2 1999 *Arbeitswelten der Zukunft*

[Huxor 1998] Huxor, A. (1998). *An Active Worlds interface to BSCW*, Snowdon, D. (Ed.), Churchill E. (Ed.): Proceedings of Collaborative Virtual Environments (CVE '98). Manchester (UK), pp.87-93.

[Klemme et al. 1998] Klemme, M., Kuhnert, R., Selke, H. (1998). *Semantic Spaces.*, K. Höök, A. Munro, D. Benyon (eds.): *Workshop on Personalised and Social Navigation in Information Space*, SICS Technical Report T98:02, Kista, Sweden, March 1998, 109-118.

[Munzner 1998] Munzner, T. (1998). *Drawing Large Graphs with H3Viewer and Site Manager (System Demonstration)*, http://graphics.stanford.edu/papers/h3draw , Published in the Lecture Notes in Computer Science series GD'98:Symposium on Graph Drawing, Montreal, Canada, August 1998

[Nelson 1980] Nelson, T.H. (1980). *Replacing the Printed Word: A Complete Literary System.*, Lavington, S.H. (Ed.): *Information Processing 80*. North-Holland, pp.1013–1023.

[Norman 1990] Norman, K.L. (1990). *The Electronic Teaching Theater.*, Interactive Hypermedia and Mental Models in the Classroom. Current Psychology: Research and Review, 9 (2), 141-161.

[Rheingold 1991] Rheingold, H. (1991). *Virtual Reality* , Touchstone, New York, London, Toronto, Sydney, Tokyo.

[Rheingold 1994] Rheingold, H. (1994). *Virtuelle Gemeinschaft: Soziale Beziehungen im Zeitalter des Computers*, Addison Wesley, Bonn and Paris.

[Robertson et al. 1993] Robertson, G.G., Card S.K., Mackinlay J. D. (1993). *Information visualization using 3D interactive animation*, In: Communications of the ACM, 36 (4), ACM, New York, 1993, pp. 57-71

[Shneiderman 1993] Shneiderman, B. (1993). *Education by Engagement and construction: Experiences in the AT&T Teaching Theatre.*, Maurer, H. (Ed.): Proceedings of ED-MEDIA 93. Charlottesville (Va.): Association for the Advancement of Computing in Education 1993, pp.471–479.

[Trevor & Koch 1997] Trevor, J.; Koch, T. (1997). *MetaWeb: Bringing synchronous groupware to the World Wide Web.*", Hughes, J. A.; Prinz, W.; Rodden, T.; Schmidt, K. (ed.): Proceedings of the ECSCW '97, September 7-11, 1997, Lancaster, UK. Dortrdrecht: Kluwer Academic Publishers, 1997, pp. 65-69.

[Wessner et al. 1998] Wessner, M., Beck-Wilson, J., Pfister, H.R. (1998). *Clear - A Cooperative Distributed Learning Environment*, Ottmann, T., Tomek, I., Proceedings of ED-MEDIA / ED-TELECOM 98. Freiburg, Germany: Association for the Advancement of Computing in Education 1998 (Vol.II), pp.1876-1877.

[Young 1996] Young, P. (1996). *Three Dimensional Information Visualisation*, Technical Report, Centre for Software Maintenance, University of Durham, March 1996
http://www.dur.ac.uk/~dcs3py/pages/work/Documents/index.html

Web Based Intelligent Tutoring System for Collaborative Learning

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Abstract: This study suggests the design and implementation of ITS study by knowledge level for distance collaborative learning in a Web situation including the diagnostic agent examining the group agent and the students involved in the program. The students involved in this learning need to have a situation whereby many are simultaneously interested in the same subject and the same type of lesson. The similarity of their knowledge and ability level enhances the effectiveness of lessons on the same subject. The diagnostic agent examines the students and the results of the examination are added to the knowledge of the group agent thereby the group agent may be able to recruit the students based on their personal characteristics and requirements. The teacher module is composed of a tutoring module and an expert module as in the basic ITS structure. Dynamic resource scheduling that uses time as a resource has been used to make a model of the students based on their requirements, knowledge level and availability of time for learning, all of which are considered important in recruiting the students for collaborative learning.

1. Introduction

Today, the advent of the Web that can easily be connected through the "Internet" is known to be an easy and popular method for teaching and learning, moreover the Web provides us with a new horizon for an attractive tutoring system. This type of model is called a Web based tutoring system. This particular way of tutoring can be defined to mean that it is an activity that transmits intentional interaction by way of the Web to promote the student's ability to develop his knowledge and competence[8].

The tutoring system now in use however is centered on a type of tutoring system stressing the power of memory in most of the lessons. Such a system, relying on memory, does not take into account the cognitive information treatment process. Therefore, it is not only difficult to stimulate the thinking process but also fails to help students make a meaningful connection between the new information they have acquired and what they already have, thus failing to produce true understanding. In order to overcome this problem, the intelligent tutoring system, called ITS, came into being. ITS is composed of four different modules – the student module, the tutor module, the expert module and the interface module[7].

The ITS in a Web situation can be dispersed and each model is called an agent capable of communicating with each other. The agent is an independent computer program capable of acquiring knowledge and reasoning and capable of automatically solving a student's projects in lieu of the student. In this study, an arrangement has been made so that the diagnostic agent and the group agent may help the students freely exchange lesson-related information and their knowledge through KQML by connecting the tutor module with the students. In addition, the students on the same level are grouped together to allow them to pursue the same category of study with individual students engaged in chat rooms, discussion groups, bulletin boards, multi-media learning and detection lesson[5]. ITS is designed in this study to allow a multitude of students to engage in collaborative learning based on the Web with the computer tutor. A diagnostic examination was made to find out the knowledge level of the students. The dynamic resource scheduling using time as a resource was also made to ferret out student who can share time with others at the same time to ensure the effectiveness of the lesson. Finally, an attempt has been made to prove the validity of ITS in connection with distance collaborative learning.

2. Structure of Web-based ITS for Collaborative Learning

2.1 Basic structure

The structure chart of this system is shown in [Figure 1]. Each client has an interface module and a student module with a server containing a tutor module and an expert module. The diagnostic agent estimates the intelligence and knowledge level of the students through a diagnostic examination based on the basic data and requirements. Information obtained will be transmitted to the group agent. The group agent then examines the other students in a Web situation based on the information. When it finds students with similar intelligence and interest in the same subject, it offers them a suggestion. When they accept the offer, they participate in the collaborative learning at a time they choose.

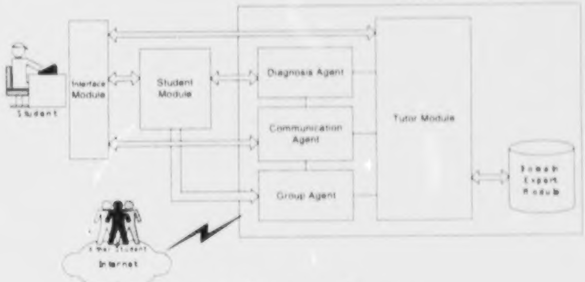
Student
Interface Module
Student Module
Diagnosis Agent
Communication Agent
Group Agent
Tutor Module
Domain Expert Module
Other Student
Internet

Figure 1. Structure of System

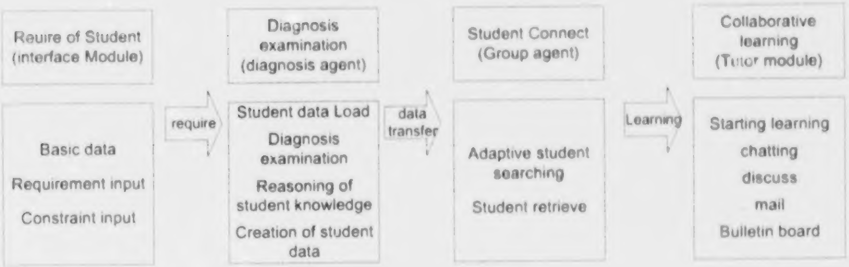
Reuire of Student (interface Module)
Basic data
Requirement input
Constraint input
require
Diagnosis examination (diagnosis agent)
Student data Load
Diagnosis examination
Reasoning of student knowledge
Creation of student data
data transfer
Student Connect (Group agent)
Adaptive student searching
Student retrieve
Learning
Collaborative learning (Tutor module)
Starting learning
chatting
discuss
mail
Bulletin board

Figure 2. System Scenario

2.2 Tutor and Expert module

The tutor module containing the lesson program and strategy provides assistance on matters related to a suitable tutoring method and any mistakes the students make based on the data from the expert module[7]. The expert module is a knowledge base storing a detailed lesson program. The tutor module and the expert module are capable of providing a variety of services and prevent the server from being overloaded by changing the server depending on the type of lesson. All the servers exchange information through the group agent and connect the students to the lessons, exchanging information about the lesson program and the server's schedule. The tutor module connected to the student module should be able to assess the student's ability dynamically and predict a new lesson program by consolidating the knowledge obtained. In addition, it should have the ability to solve stereotypical problems by using stored plans and design a new lesson program through revision and adjustment[2].

The portion to be expanded and restructured is the mutual sharing of the knowledge that can be achieved by connecting the outside "Internet" to the knowledge base. The expert module and the tutor module may be supported through various multi-media material such as graphics, music, voice, animation and various communication methods such as mail, chatting, web board and monitor conferences[5].

2.3 Student module

The individual student model structured by the student model. The student model is composed of all the facts obtained through interaction between the students and the expert module and the basic information of the students are placed into it by the interface module. The student's basic input data and requirements for lessons are as shown in <Table 1>.

The student module is stored in the form of knowledge of frame and managed in three categories - the basic student data (limiting conditions and requirements), information about the diagnostic evaluation, assessment of the student's intelligence level with lesson environment. Information for the student module is inserted by interface. Diagnostic evaluation and lesson assessment results are stored with other student information file for future use in lesson scheduling.

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Classification	Item	Instance
Basic Input Data	Name	Han sun gwan
	Sex	M
	Age	11
	Grade	5
	Language	Korean
Requirement (Constraints)	ID	Fish
	Study Course	Math
	Lesson	Figure
	Date	Mon, Wed, Thu
	Time	PM 7-10 and AM 2-5
	Study Time	3 Hours
	Member	4~8
Student Attributes	Contents	Figure
	Study Time	4 Hours
	Knowledge level	3Level (CF 0.9)
	Relation of Study	Interest: high
		Endurance: good
		Relation course: Science
		Study Manner: Very good
		Evaluation: 90 point

Table 1. Student Module

2.4 Diagnostic agent

The diagnostic agent composed of diagnostic rules for the student maintains and controls a student model by analyzing the student's behavior. A library list of mistakes students are liable to make is made and indicates the level of the students. The diagnostic agent indicated degree of understanding for each item of the Bug Library and records its history. For flexibility, the diagnostic agent delays a decision - making a student model with inaccurate knowledge might attempt to make on interaction with the students. A few limiting factors such as the required time and the number of interactions are applied to filter a student's mistakes and errors on time difference. It also revises the student model when it recognizes a student's misconception and estimates the student's intelligence level based on the revised numerical values, basic data and input material. Such numerical values are stored back into the student's module for use by the group agent in recruiting the students.

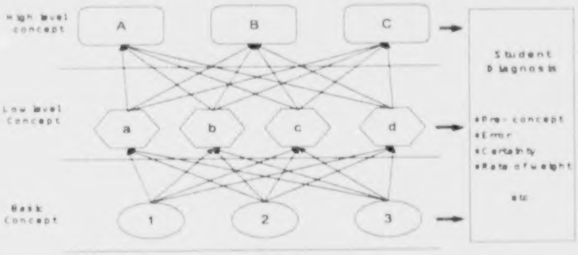

Figure 3. Leveled Diagnostic Process Model

The diagnostic process includes checking answers to the questions for correctness, solution time, degree of difficulty, Weight rate and is expressed in the form of a Rule Base System. Information regarding the assessment may be converted and updated according to the learning area.

2.5 Group agent

The group agent is an agent evaluating and recruiting students based on their intelligence level showing basic data (limiting conditions) and diagnostic assessment. The communication between the student module and the diagnostic agent is made possible through KQML. The information transmitted by KQML should be filtered and inter-mediated according to the lesson hours, subjects to be studied and intelligence level. In particular, scheduling for a lesson in the same area at the same time with a large number of students will complicate the scheduling.

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At first, the students who can participate in the lesson is sought by taking into account the limiting conditions and checking the availability of time. The server is divided into "full", "common" and "empty" and the student's time is divided into "good", "yes", "no", carefully comparing the time availability between the server and the students and removing improper times ("no" or "full") one by one. When the lesson hour is the same, the students are given a certain amount of time and a proper amount of time is allotted to the inappropriate students by loosening ("common" or "?") the limiting condition.

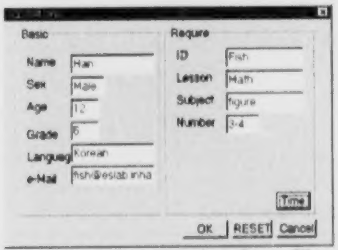
Having too many students at one time poses another problem. In this case, the time could be given to the students by using an evaluation function. The evaluation function can be evaluated based on the student's behavior as supplied by the diagnostic agent. As such, each agent selects the best students through competition.

2.6 Communication agent

The communication agent provides various multi-media services in the lesson environment by connecting the students and controlling them. The type of service that can be provided includes chatting, a white board system, a multi-media player, mail management, user management, VOD and bulletin boards used in the existing Web.

3. Implementation and Consideration

The ITS designed and implemented in this study showed the interface and communication service by utilizing JAVA and C++ and diagnostic examination and preparation of lesson contents were made with the use of KAS(Korea Authoring System). JESS(Java Expert System Shell) was used for engine pattern matching and KQML was used to exchange messages between the agents. Users basic data and requirements placed through the interface module are shown in [Figure 4] and the numerical values inserted through the interface module are used for the student module.



Name Han
Sex Male
Age 12
Grade 6
Languag Korean
e-Mail fish@eslab.inha

ID Fish
Lesson Math
Subject figure
Number 3-4

Figure 4. Basic data input interface

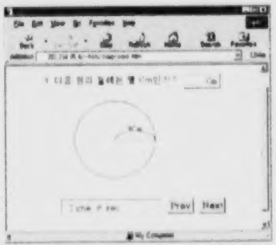
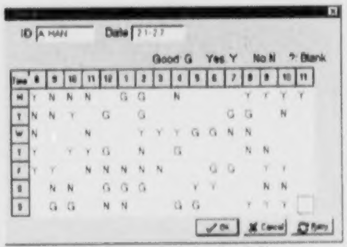


Figure 5. diagnostic examination by level



ID A HAN
Date 21-27

Good G Yes Y No N ?: Blank

Time	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
M	Y	N	N	N		G	G		N				Y	Y	Y	Y
T	N	N	Y		G		G					G	G		N	
W	N			N			Y	Y	Y	G	G	N	N			
T	Y		Y	Y	G		N		G				N	N		
F	Y	Y		N	N	N	N	N			G	G		Y	Y	
S		N	N		G	G	G			Y	Y			N	N	
S		G	G		N	N			G	G			Y	Y	Y	

Figure 6. lesson hour scheduling

For diagnostic examination, the student's intelligence level was checked by using the KAS program which includes 20 questions as shown in [Figure 5]. The questions are all related to each other with 10 questions for reliability and another 10 questions for checking the student's level. Each question has a time limit with a weight rate and a degree of difficulty added to it, which makes it possible to determine objectively the student's knowledge level. The problem solving process of the student's behavior, number of interactions made and their intelligence level were put in the student module following the revision and adjustment.

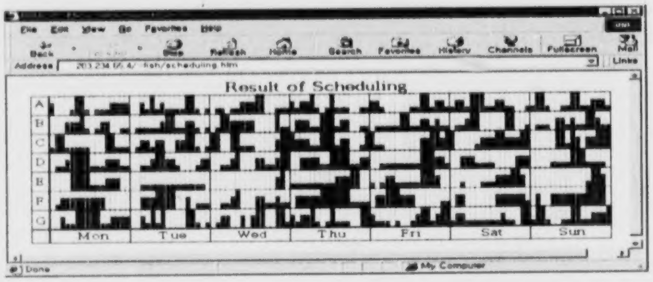


Figure 7. Over-all scheduling results

The scheduling for lesson hours implemented in this study included 7 students as shown in [Figure 6]. The students transmit their preferences for time and day of the week. Group agent initiates the scheduling by

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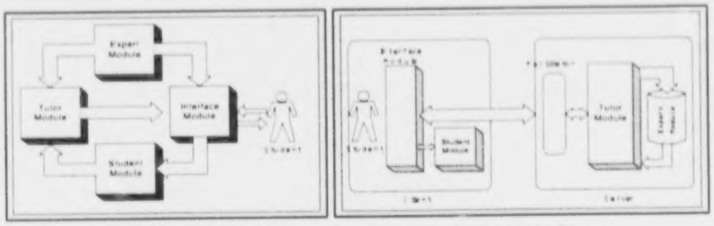
obtaining the numerical values as shown in [Figure 6] and show the server's itinerary and arrange the student's schedules in a line. Next, it removes the server's "full" and the time the student selected as "no" and extract the server's empty portion and the time students selected as "good". In a case where there are too many students, time is given to the appropriate number of students, using evaluation function. In a case where there are few students, the server's "common" and "good" or "yes" which students selected are extracted by loosening the limiting conditions. As shown in [Figure 6], scheduling has been made so that students A, D, E and G join the lesson between first and second hours on Monday, with B, C, and F joining the lesson between the 2nd and the 4th hours on Thursday. Over-all scheduling results obtained from the scheduling of the lesson hour implemented in this study are shown in [Figure 7].

4. Background

4.1 ITS based on Web

An ITS structure suggested to overcome the shortcomings of CAI - a static and across-the-board lesson - is shown in [Figure 8-a].[7]



a : ITS

b:Web based ITS

Figure 8. Basic ITS and Web based ITS

The model of the traditional ITS was a "stand alone" type allowing a single user to pursue knowledge as the single computer contains all kinds of modules. The disadvantage this type of structure has is that the knowledge of a variety of students can not be accumulated and shared. In addition, the inability to provide a variety of learning methods makes it impossible to share the multi-media information and interaction between the human-computer interaction (HCI) and human-human interaction(HHI). However, ITS enabled us to share the knowledge with the development of the Web environment through the "Internet" and ITS itself followed its course of development in a dispersion environment as shown in [Figure 8-b]. If we look at the ITS structure based on the Web, the student module and the interface module are situated as clients and the tutor module and the expert module as servers allowing many students to share the knowledge. The peculiar dispersion environment produced the need for a communication agent and an adjustment agent for proper communication between the clients and servers.

4.2 Agent system and KQML

The agent is a program with intelligent characteristics to help the users with the use of computers and take the user's place. The intelligent agent perceives any dynamic stimulation or condition and interprets the data collected for a solution to the problem and exercises reasoning for a final decision. It also act to change the conditions within its environment in order to perform assigned duties[1]. It has autonomy, social ability, reactivity, pro-activeness and a cooperative relationship and falls under the three different categories listed below[6].

-*A single agent* provides service to the users in its unique area such as assistant agent system, the user interface agent and the intelligent agent system.

-*A cooperating agent* is also called a multi-agent and provides necessary service for mutual cooperation in order to achieve the common objective.

-*A society of agent* is also called a mobile agent and provides necessary service by moving to an area wider than the cooperating agent.

The dialogue between these multiple agents is exchanged according to the established language agreement. The message takes the form of data, logic information, command and script. The ACL(agent communication language) - a common communication language - is normally used among the programs shaped with different languages. Representative language is called KQML(knowledge query manipulation language) developed by

DARPA. KQML not only provides words with grammatical structure for first order logic messages based on a speech-act theory but also contains a communication agreement, including the structure to allow the agents and programs to exchange information and knowledge[6].

4.3 The problem of dynamic resource scheduling for lesson hours

Scheduling the lesson hours should be prepared in such a way as to satisfy the limiting conditions such as the preferred lesson hours, the existing individual schedules and the plans to alleviate the burdens of the server for effective learning. The students have a certain time they prefer for an effective lesson and they prefer using a certain time for lessons due to their previous schedules. The preferences, however, vary according to the student as do their current schedules. Furthermore, even when collaborative learning is started, it is difficult to achieve effective lessons due to the noticeable reduction of wireless transmission speed caused by the server being overcrowded by many users at one time. It has to spend a lot of time and effort using a systematic method in order to alleviate and satisfy the limiting conditions[3]. The problem of adjusting these problems belongs to the dynamic resource scheduling which has the following limitations:

-The individual students have their own schedules and it is possible that these schedules cannot overlap each other.

-The students have a certain time they prefer for more a effective lesson.

-Their level of intelligence may vary.

-The server has its own schedule and is not in a position to accommodate large numbers of users.

Many of the students may attempt to use the lesson hours in their favor for better lessons. Since they manage their own schedules, the information and the knowledge related to the lesson hour scheduling are dispersed, leaving everybody unaware of the over-all lesson activities. This is characteristic of the dispersion system and the students may clash with each other because of this phenomenon. In order to avoid this kind of clash, the agent should find negotiating tactics to select appropriate students and a good scheduling method.

5. Conclusions and future work

In this study, the diagnostic agent and the group agent that realizes collaborative learning have been implemented based on the ITS student module for student's distance collaborative learning. It has presented a more expanded Web-based ITS by overcoming the shortcomings of the existing ITS. The diagnostic agent helped realize the lessons by level by supplying the results of the student's intelligence level assessment to the group agent and the group agent helped with the lesson by assigning a suitable time based on the student's requirements and limiting conditions. Scheduling has been made so that student may have a chance to learn with the most suitable students by competing with a multitude of students.

The teaching tactics module and the expert module are capable of sharing and expanding the knowledge together, creating a variety of student models through mutual communication with the help of KQML. In the future, a study to improve the insufficient portion of the tutor module and an expert module including a variety of exchanges in tutoring methods are urgently required. More study is required in structuring an accommodative student model. The research and rectification of the difficulty in assessing the intelligence level of a group often found in collaborative learning and the misconception held by the group as a whole are a must. Structuring a new student model by assessing a multitude of student models is also considered to be another area of research.

References

[1] Barbara Hayes-Roth.(1995). "An Architecture for adaptive intelligent agent systems", Artificial Intelligent, Vol 72, pp.329-365,.

[2] Choo Monwon, Choi Youngmi.(1998). "Adaptive tutoring agents", Korean Association of Information Education, Vol 2, Nov. pp.201-207.

[3] E.H. Durfee and S. Sen.(1992). "A formal analysis of communication and commitment in distributed meeting scheduling", 11th Workshop on DAI, Feb. pp.333-344.

[4] Moises, L. and Thomas, D.(1996). "A Framework for the Development Architecture", IEEE Expert, Dec. pp. 47-59.

[5] Marry A. Nixon.(1998). "Collaborative learning Web Based Instruction", AAAC, Nov.

[6] Nicholas R. Jennings.(1995). "Intelligent Agent", Springer Verlag, pp 1-28.

[7] Shim Leem Seop.(1994). "Intelligent Tutoring System", Korea Information Science Society Review, Oct..pp 52-69.

[8] Http://www.kmec.net/malsm/wbi/index.html

[9] Http://herzberg.ca.sandia.gov/jess

[10] Http://www.alphaworks.ibm.com/formula/jkqml

Mandatory Participation as Examination

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Abstract: This paper discusses examination, focusing on the possibilities available in asynchronous learning networks (ALN) based education. An ALN supports anywhere/anytime collaborative learning and this research has explored suitable examination forms in this setting. The notion of mandatory participation in learning activities is argued to be more viable in ALNs rather than traditional classrooms. Mandatory participation as the primary examination criteria was used and evaluated in a higher education ALN based course, resulting in several key experiences which are presented and discussed. These experiences contribute to a richer understanding of problems and difficulties involved in ALN based courses.

1. Introduction

It is often argued that the post-industrial society requires skills and abilities that are different from what traditional education focuses on, for example regarding teamwork, systems thinking and communication. When information is abundant in society the goal of learning is no longer memorization of facts. Instead we learn to learn, and engage in a life-long learning process. As a result, learner-centered education has emerged as a contender for the dominating learning philosophy [Norman & Spohrer 1996].

Constructivism and collaborativism are two related learning models which are learner-centered. Constructivism denies the existance of an objective reality; reality is a unique world-view related to each individual's mind. Rather than passively absorbing transferred knowledge, knowledge is actively constructed by each learner. The collaborative model of learning differs from constructivism by focusing on learning as a result of interaction among individuals. Learners construct an individual understanding through reflective discussion and confrontation with others' understandings, and also improve communication and listening skills. See for instance [Leidner & Jarvenpaa 1995] for an in-depth discussion on different learning models.

Constructivism and collaborativism stress active participation in the learning process. Passive individuals do not learn, so learners must be motivated and engaged, and instructors should support rather than control the learning process. Course organization and incentives must facilitate and promote active participation. It is easy to assume that students naturally should participate actively, but reality is complex and students often choose other learning strategies.

Perhaps the most important influence on learning strategies and outcomes is the examination procedure. Courses have an official curriculum, but the examination procedure constitutes an unofficial hidden agenda. For meaningful learning to occur, examination, i.e. the hidden agenda, must be congruent with the learning philosophy [Ramsden 1992]. If examination procedures in practice promote different learning strategies than intended, official curriculums have little, or no effect.

This research attempts to explore suitable examination forms for net based collaborative learning. Net based learning environments offer possibilities unavailable in traditional classrooms, possibilities which are discussed below, and make active participation a realistic option for examination criteria. We propose mandatory participation as the primary examination criteria in net based collaborative learning. The idea of mandatory participation guided the design of a higher education course which was realized and used for the evaluation. 85 students participated in the course, where the authors were teaching assistant and course coordinator respectively. Key experiences from the evaluation are presented to give a rich understanding of problems and difficulties involved in net based collaborative learning.

2. Asynchronous Learning Networks

For the remainder of this paper, instead of using the term net based learning environment we will adhere to the established concept of asynchronous learning networks (ALN). An ALN is a net based learning and teaching environment where possibilities and problems are different from traditional classrooms. A distinct characteristic of an ALN is the notion of anywhere/anytime learning. ALNs are often built using different tools for computer mediated communication, for example email, bulletin boards and newsgroups, synchronous chat systems, computer conference systems, group decision support systems, and most recently, the World Wide Web [Hiltz & Wellman 1997].

In an ALN, learners form a community engaging in collaborative learning at the time and place of the individual learner's convenience [Bourne et al. 1997]. By slowing down interaction, learners are given time for reflection, and ideas, questions, comments, etc. can grow and mature before being shared with other learners. Articulating and making understandings explicit is a learning process in itself, and knowing that ones work will be available for other learners is motivating and brings out high efforts. Active participation in learning activities, for example discussions, is crucial for successful learning; this is proclaimed in most research on ALN based collaborative learning.

Learning processes and the role of educators and learners in ALNs can be radically different from traditional classrooms [Harasim et al. 1995]. An important issue to remember is that ALN based learning is a social process, or in other words: "though the classroom is virtual, the relationships and the learning it supports are real" [Hiltz & Wellman 1997]. Social skills, status, preferences, traditions, etc. affect the success of individuals and groups. See for instance [Wegerif 1998] for a discussion on the social dimension of ALNs.

The next section will discuss the relation between participation and presence, after which we suggest an integration of learning and examination relying on the unique possibilities offered by ALNs.

3. Participation Versus Presence

A somewhat controversial discussion about participation versus presence highlights some weaknesses of traditional classrooms and strengths of ALNs. To be present is simply to passively attend group sessions, and to participate is to actively contribute to group sessions. Attendance does not imply active participation and this is where traditional classrooms are, we claim, weak. In a traditional classroom learners can attend, not be active participants, and seemingly participate. In an ALN one cannot just attend; lurkers are invisible and to be visible participation, that is interaction with other learners, is necessary.

Participation vercus presence is more than an issue of control; it is also an issue of equality. Learners who try to actively participate can be hampered by various social factors. Whereas in traditional classrooms learners must be allowed into the discussion before speaking, in an ALN learners are part of the discussion at all times; there is no slow turn-taking which keeps ideas and comments on the sideline. Time passes quickly in real-time discussions and many learners have difficulties to find ideas under such extreme time pressure. In ALN based discussions ideas can grow over a longer time period and also, considering that contributions are situated in a discussion context, the moment where the contribution is suitable is longer. In traditional classrooms discussions change direction rapidly and the right moments are brief. Other social factors are for instance gender issues, nervousness and self-confidence, and language differences. ALNs do not always have a positive impact on equality, for instance the permanent nature of text in discussions can be considered uncomfortable and limiting as opposed to casual talks.

Considering the importance of active participation for collaborative learning the discussion of participation versus presence leads us towards a starting point for the evaluation: The notion of mandatory participation in learning activities is argued to be more viable in ALNs rather than traditional classrooms.

4. Mandatory Participation

ALN based courses are well-suited for active participation in learning activities. This makes it viable to consider active participation as the criteria of examination. Current educational practices intend for examination forms to support, or at least not hinder, learning, but in practice the examination forms are often unaligned with the learning philosophy. An alignment of learning philosophy and examination, thus making examination an integrated part of the learning process, is suggested: Collaborative learning stresses active participation; ALNs support active participation. Therefore this paper proposes mandatory participation as the primary examination form in ALN based courses.

Mandatory participation seems to offer an almost seamless integration between examination and learning, which is in line with the notion that one cannot separate examination from learning. Demanding active participation is a bold and radical move considering that in most cases participation in ALN based discussions is optional and examination consists of assignments such as essays at certain times. However, considering the characteristics and demands of collaborative learning, it seems a very natural move.

As discussed above anywhere/anytime learning is a key issue for ALNs. Participate wherever and whenever you want but participation is mandatory. Learners are used to mandatory attendance in physical spaces but mandatory participation, not only attendance, in virtual spaces is new for learners. As it is accepted with mandatory lecture attendance, we say: If you cannot participate, then why are you taking this course? Certainly voices will be raised about inequality concerning computer access. We however consider the time has come when computers are widely available. Large investments have been made to increase the number of campus computers and many people have computers at home.

This of course sounds harsh and perhaps naiv but it is a main ingredient if participation is to be mandatory. In the next section we will discuss the evaluation of the concept of mandatory participation in an ALN based course.

5. Evaluation

The concept of mandatory participation guided the design of an introductory course in Informatics. Mandatory participation is a continuous form of examination where learners must be "reasonably" active throughout the course. Therefore, learning activities must be evenly spread over the course duration; learners can be more or less active over time so the total participation determines examination outcome, not large assignments at certain times. In order to achieve this flexibility in participation the course was structured using thematic modules (TM).

TM is a structuring philosophy which divides the course into several self-contained units [Nulden 1999]. This is different from traditional modular structuring where a large topic area is divided into subtopics small enough to digest for learners, like chapters in a book. In TM each module introduces a separate issue or problem, like tiny islands in a vast ocean of knowledge. Every module has a well defined beginning and ending. Because each module is self-contained learners can be more or less active in different modules according to interest and outer circumstances, as long as the total participation is satisfactory.

The introductory course in Informatics was given for undergraduate business administration students. Each module was initialized with a, hopefully inspiring and challenging, two hour lecture. The rest of the week-long module consisted of discussion in groups in the ALN and an end-of-module summary provided closure. The course lasted for 10 weeks, that is covering 10 modules, and awarded 2 credit points. 85 students were entered in the course and they were divided into five groups, each having a teaching assistant (TA) to facilitate and support online discussions. One of the TAs' responsibilities was to inform the course coordinator about students who were not fullfilling examination requirements. The course coordinator would then review the students effort and be fully responsible for any final decision to fail the student. Deciding if a student's participation fullfilled the examination requirements was in some cases difficult. Some limited tools, i.e. visualizations, were available to make it easier to understand each individuals participation level but these were apparently not enough. However, the issue of technology support for TAs is beyond the scope of this paper but has been discussed in a previous paper by the authors [Hardless & Nulden 1999] and is an important area for future research.

The main part of the ALN used for the course was a conference system that was hierarchically structured. [Fig. 1] shows screenshots of the interface. Each group had a separate area, i.e. folder, and within the group folder there were 10 folders, one for each module. During a module the group would create appropriate discussions in the current module folder. Discussions were containers for messages and, as we can see in [Fig. 1], new messages were appended to a vertical list of existing messages. New messages were also sent to the students with e-mail as a notification service. In this case the ALN was highly-structured but this is not a requirement for TM in general. TM is a flexible structuring philosophy and can be adjusted to different settings and intentions.

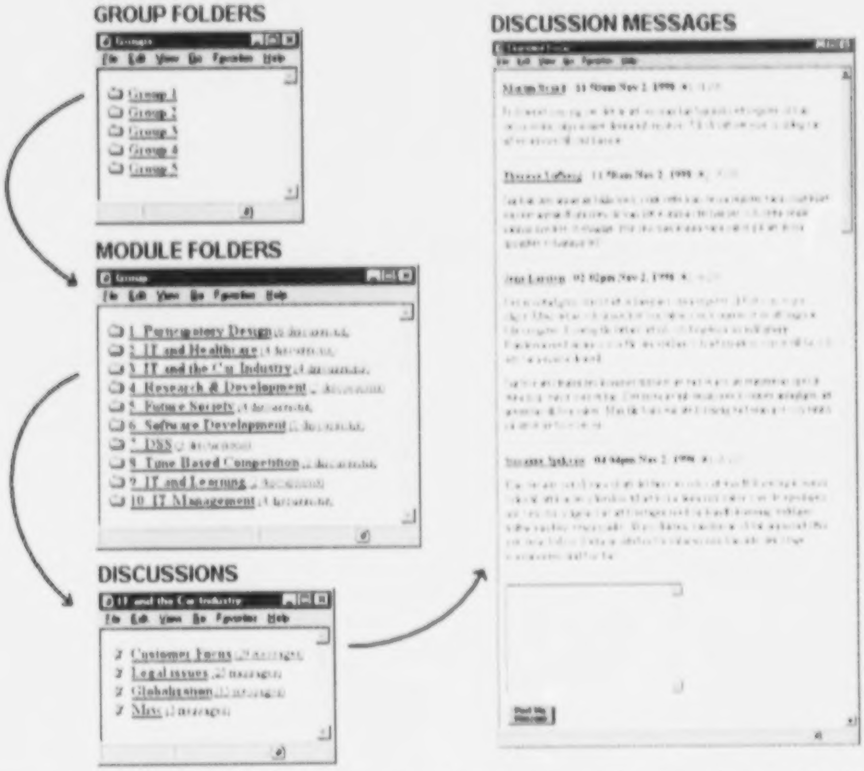
GROUP FOLDERS
Group 1
Group 2
Group 3
Group 4
Group 5
MODULE FOLDERS
1 Participatory Design
2 IT and Healthcare
3 IT and the Car Industry
4 Research & Development
5 Future Society
6 Software Development
7 DSS
8 Time Based Competition
9 IT and Learning
10 IT Management
DISCUSSIONS
IT and the Car Industry
Customer Focus
Legal issues
Globalization
Misc
DISCUSSION MESSAGES

Figure 1: Screenshots of the highly structured conference system used as the main part of the ALN.

Halfway through the course the course coordinator and TAs thoroughly discussed students' participation and five students were judged to be non-participant and as an effect of being failed they were no longer allowed to access the ALN. It should be noted that the learners were judged leaniently; only very apparent cases of low participation were failed. This does not mean students passed for free; only that, because determining resonable participation is difficult, we decided to rather pass than fail the uncertain cases. For the second half of the course none of the remaining students neglected participation and so they all passed the primary examination. Having passed the primary examination they were allowed to complete the secondary examination which was an end-of-course assignment determining the final grade.

In practice, mandatory participation as the primary examination criteria turned out well. There were some complaints on problems in accessing computers, as expected causing a conflict with the mandatory participation demand, but this was a minority of students and they managed alright despite this problem. Many students wanted us to reserve campus computers for them regularly but we did not since this conflicts with the notion of anywhere/anytime learning.

6. Experiences

We will share some of our experiences, or anecdotes if you wish, from the evaluation which are broadly related to mandatory participation. These experiences serve to give some depth in the understanding of problems and difficulties involved in ALN based learning and mandatory participation. Some of the experiences might seem irrelevant at first but participation depends on many factors and thus a broad account gives a better understanding of success and failure.

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6.1 New and Different

The ALN based course proved to be in sharp contrast with regular courses which the students had experienced previously. The shift from teacher-centered to learner-centered education was somewhat of a revolution.

Technology-wise it was certainly a change in that the course was ALN based but students were relatively familiar with computers and the Internet. The students were given a brief manual for the system, a short demonstration, and an optional half-day workshop. The few computer novices learned quickly and some of them remarked afterwards "oh, was it that simple…".

The revolution concerned the learning philosophy. Students were not used to collaborative learning, unstructured tasks, open-ended discussions, and the notion of producing knowledge for themselves rather than the teacher. They were hampered by a textbook focus and lack of initiatives. Roughly they were asking: "What are the exact examination criterias and where is the final written exam?"

Many of the lecturers, especially those who were teachers, were also stuck in the traditional view on learning. Their lectures were not percieved by the students to serve as a motivating starting point. Understanding the lecture as a starting point instead of an overview or summary is a difficult change process. Interestingly, the most appreciated lectures were those performed by professionals from the industry.

For the course coordinator and TAs it too was a new and challenging situation. We had little previous experience of this new form of learning and knew it would be a difficult process, for us and foremost the students. Therefore we decided to have a very positive and generous attitude, by for example having extended office hours. Introducing the ideas to the students was not trivial. Convincing them to commit and engage in collaborative learning was problematic and is a key issue for the success of ALN based courses.

6.2 Off-Topic Discussions

We identified two cases where students engaged in off-topic discussions. The first concerns non-serious discussion, i.e. topics not related to the course. The second concerns students posting to serious discussions but with the intent to pass examination, not contributing to the learning process.

Examples of non-serious discussions were sports discussions, tv-show discussions, and music discussions. Each of the five groups created about two such discussions and, unlike the serious discussions, these lasted throughout the course. These discussions were popular judging by the volume of messages they recieved, for instance one discussion about icehockey recieved 140 messages. The tone of voice was different compared to serious discussions; more relaxed. One, unintentional, problem was that all messages were also sent as e-mails to participants. The volume of e-mails was already high enough without off-topic messages so this became a source of annoyance. This leads us to claim that non-serious discussions should be kept totally separate from serious ones; not so much where they are placed but more importantly avoiding interference issues such as ours.

The second type of off-topic discussions concerned students feeling the pressure to say something in order to pass the examination. Because we had an open-minded and friendly attitude towards the examination many students dared to admit posting not to contribute to discussions but to meet examination criteria, that is they posted just for the sake of it. Some joked about the need to say something serious quickly in the beginning of the module before everything was said. Especially during the first modules students tended to post similar messages, rather than building on each others contributions. Another reason for low-quality messages was the problems in accessing computers. The affected students simply had to do everything at once when they found a computer, that is read, think, and post. There was no room for reflection since leaving the computer and coming back later to post was unthinkable.

6.3 Mature and Evolve

Above we discussed how new and different ALN based collaborative learning was for students. During the course we also noticed how students changed attitudes, learning strategies, etc. We feel that at first many students had difficulty seeing the point in collaborative learning but over time some students revised their attitude to this way of learning and realised that one can learn from interaction with other learners. Of course, not all students were convinced and 10 weeks is a short time to change ones perception of what learning is. We do however believe that the new experience will have started a thinking process within most students which will lead to critical and reflective examination of the learning they participate in later. Even if they did not see the point of collaborative learning directly, they might think differently in a year or two.

Also, students at first had trouble with the mandatory participation criteria. As one TA expressed it: "Initially my students thought mandatory participation meant they had to be constantly present in the ALN. This caused frustration and they said: 'Be there all the time? This can't be? We have other things to do!'. Gradually they realised what we meant and eventually they started working as intended with about one visit per day to update themselves, reflect, and post messages."

6.4 Teaching Assistant Frustration

One of the TAs' responsibilities was to stimulate students who were inactive and not participating in a satisfactory manner. The first difficulty was to decide when a student was not reasonably active. All TAs had different personal styles but none wanted to appear bossy or bad tempered, so pushing students was difficult, especially when faced with a borderline case of inactivity. This gives us the second difficulty; how to approach students and give them a friendly push. Another practical issue is being able to contact students. Sometimes reaching inactive students was impossible because they did not participate in the discussions and we did not always have their emailaddress. A TA should always be able to reach all of her students.

The TAs mainly tried to facilitate discussions and help students reach higher levels of understanding. Sometimes a TA might say something really interesting and challenging, only to be disappointed when no reaction was triggered. Either the students were not interested in the new discussion option or they simply lacked the experience to build on feedback which was too advanced. Giving appropriate feedback is a very complex issue and it is further complicated by the fact that the students all have different backgrounds, experiences, and preferences.

7. Conclusion and Future Work

In this paper we have discussed the idea of mandatory participation as examination in ALN based courses. The evaluation indicates that it is a viable examination form for ALN based collaborative learning. However, our experiences show that the alignment between learning and examination was not complete since many students took on learning strategies purely focused on passing examination. This was our first evaluation of mandatory participation as examination so of course further research is needed. A multitude of issues need to be explored further, such as facilitating learning processes, technology support for participants, other ALN based examination forms, and how to further integrate learning and examination.

8. References

[Bourne et al. 1997] Bourne, J. R., McMaster, E., Rieger, J.. & Campbell, J.O. (1997). Paradigms for On-Line Learning: A Case Study in the Design and Implementation of an Asynchronous Learning Networks (ALN) Course. *Journal of ALN*, 1 (2), 38-56.

[Harasim et al. 1995] Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning Networks: A Field Guide to Teaching and Learning Online*. Cambridge, Massachusetts: The MIT Press.

[Hardless & Nulden 1999] Hardless, C., & Nulden, U. (1999). Visualizing Learning Activities to Support Tutors. *Extended Abstracts of CHI '99*, ACM, Pittsburgh, 312-313.

[Hiltz & Wellman 1997] Hiltz, S. R., & Wellman, B. (1997). Asynchronous Learning Networks as a Virtual Classroom. *Communications of the ACM*, 40 (9), 44-49.

[Leidner & Jarvenpaa 1995] Leidner, D. E., & Jarvenpaa, S. L. (1995). The Use of Information Technology to Enhance Management School Education: A Theoretical View. *MIS Quarterly*, 19 (3), 265-291.

[Norman & Spohrer 1996] Norman, D. A., & Spohrer, J. C. (1996). Learner-Centered Education. *Communications of the ACM*, 39 (4), 24-27.

[Nulden 1999] Nulden, U. (1999). Thematic Modules in an Asynchronous Learning Network: A Scandinavian Perspective on the Design of Introductory Courses. To appear in *Group Decision and Negotiation*.

[Ramsden 1992] Ramsden, P. (1992). *Learning to Teach in Higher Education*. London: Routledge.

[Wegerif 1998] Wegerif, R. (1998). The Social Dimension of Asynchronous Learning Networks. *Journal of ALN*, 2 (1), 34-49.

Exploring Electronic Media and the Human Mind - a Web-Based Training Module

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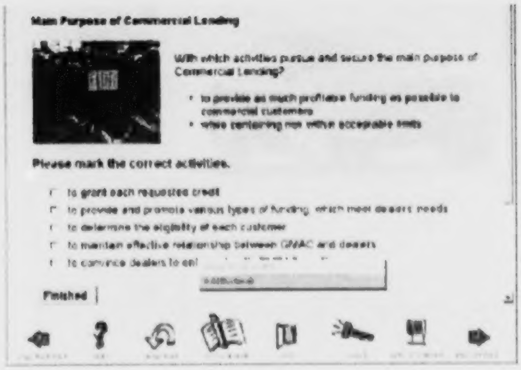
Abstract: Effective Web-based training (WBT) has a need for adaptation and contextual information, but most WBT modules provide not more than some simple help pages or hypertext facilities with keyword indices. Help pages mostly provide information how to access functions but not how to apply them - and why. Therefore, we designed a generic Web-based Performance Support System (PSS) that can be used as a stand-alone training course about 'Learning in electronic media' or as an integrated help system supporting other WBTs. The PPS provides four modules, a comprehensive glossary, a keyword and a full-text index as well as a graphical overview with brief summaries of all modules. In order to motivate users to apply learning strategies we integrated about fifty so called brain tests: Each test consists of short psychological experiments which can be easily conducted within a few seconds and illustrate important features of human perception and human memory. First experiences ascertained that it is highly motivating for students to test their own perceptions and learn about human cognition.

Introduction

Learning effects of multimedia in education are disappointing, quite frequently. Van den Berg and Watt (1991, pg. 119) compared multimedia in competition to a classroom lecture, multimedia supplementing a lecture and multimedia replacing a lecture. They drew the conclusion: 'Objectively the academic performance of (multimedia) users was not different from those attending classroom lectures [...] Although, positive about (multimedia) technology, they indicated that they would prefer to use it as a supplement to lectures and books.' Meta-analyses support statements like these. Kulik and Kulik (1991) examined 248 research studies about computer-supported learning. 150 studies failed to show any significant effects. The other studies showed only a slight advantage of multimedia over textbooks or lectures. Considering all studies included into the meta-analysis, multimedia produced only a small effect (Hasebrook, 1995). Although, multimedia seems to save some time and reduce simple errors, it has not been found to be very effective as a problem solving tool (Mayer & Anderson, 1992).

There are some promising studies, however, showing that multimedia could potentially facilitate the learning processes. The Software Publishers Association (1995) reviewed the effect of instructional technologies in 133 school studies from 1990 to 1994. It was stated that there were better test results, an increase in self-reliance and a closer interaction between students and teachers. Many other studies have confirmed that multimedia applications enhance learning, only if the individual skills and abilities match the demands of the learning task and the functionality of the multimedia system (e.g. Barba, 1993; Mayer & Sims, 1994). Therefore, it is necessary to teach users strategies and concepts to use multimedia applications. Additionally, it is necessary to adapt the system to individual abilities and the overall learning environment (Schulmeister, 1996; Larkin & Chabay, 1992).

Many vendors and users prefer a stepwise migration from 'old' to 'new' technologies. For instance, Bank Academy has implemented a multimedia CBT in charge of the financial department of an international automobile manufacturer and dealer (cf. figure 1) which was implemented in five different languages and delivered on CD-ROM. One of the challenges of this project was to produce off-line and on-line training courses in a single production process. Therefore, we implemented the different CBT versions using the Hyperwave Information Server (Maurer, 1998) in order to maintain the multimedia elements. Hyperwave directly delivers Web-based training, because it includes a complete Web server, and allows to produce a 'snapshot' of the database which can be delivered on a CD-ROM. Up to now, the training course does not provide more than a traditional multimedia CBT. But in the year 2000 the course will be put on-line and therefore integrate Hyperwave's on-line features, such as note taking, discussion forums and bulletin boards.



Main Purpose of Commercial Lending

With which activities pursue and secure the main purpose of Commercial Lending?

- to provide as much profitable funding as possible to commercial customers
- while containing risk within acceptable limits

Please mark the correct activities.

☐ to grant each requested credit
☐ to provide and promote various types of funding, which meet dealers needs
☐ to determine the eligibility of each customer
☐ to maintain effective relationship between GMAC and dealers
☐ to convince dealers to ent

Finished

Figure 1: Advanced Web servers like Hyperwave allow to introduce Web-based training starting with off-line multimedia CBTs; this approach has been choosen in an project of Bank Academy in charge of an international automobile manufacturer.

From Help Pages to Performance Support Systems

Duchastel (1992, pg. 69) claims: 'Adaptation is essence of what is known as pedagogical knowledge'. Many researchers aim to make their multimedia systems more adaptive – and therefore more 'pedagogical' (e.g. Cox & Brna, 1995). Expert systems and Intelligent Tutoring Systems (ITS) adapt to the learner's demands, abilities and knowledge – especially in subjects which can be described in formal structures (Bastien, 1992). There is an increasing number of adaptive computer programs which are equipped with media like videos and photographs. As of today, a diverse spectrum of techniques, approaches and philosophies impede the progress in intelligent learning environments (Self, 1992). There are promising results, however, supporting positive effects of intelligent learning environments teaching mathematics and programming (e.g. McGraw, 1994). In general, effects of adaptation and system-controlled tutoring have been small or medium sized, yet (e.g. Schulmeister, 1996).

Despite these insights about the need for adaptation and contextual information many Web-based training modules provide not more than some simple help pages or hypertext facilities with keyword indices. Help pages mostly provide information how to access functions but not how to apply them in different learning contexts - and why to apply them. Effective learning needs a good deal of verbal and visual literacy, whereas computer literacy seems not to be the most influential factor (cf. Mayer & Sims, 1994; Mayer & Anderson, 1992). Thus, most help systems do not support learning strategies to cope with linked multimedia elements, and they do not motivate to use electronic media as an serious learning tool. Effective help systems should support the user to overcome his or her weaknesses and take advantage of her or his strength. We therefore designed a generic Web-based training system that can be used as a stand-alone training course about 'Learning in electronic media' or as an integrated help system supporting other Web applications (cf. figure 2). Thus, it can be used as a Performance Support System (PSS) to enhance utilizing electronic media in an learning and in working environment (McGraw, 1994). The PPS provides four modules, a comprehensive glossary, a keyword and a full-text index as well as a graphical overview with brief summaries of all modules. The table of contents comprises the following topics:

- Learning with multimedia: Advantages and disadvantages of computer-based training - Appropriateness of multiple media - Learning strategies for multimedia - Combining dynamic and static media - Self test 'Multimedia expert'.

- Information from the Internet: Basics about the Internet - Addresses in the Internet - Search engines and search strategies - Self test 'Internet expert'.

- Email and Computer Conferences: Basics about email - Writing emails - Mail and list server - Asynchronous and synchronous computer conferences - Video conferencing - Self test 'Email expert'.

- Learning strategies for CBT: Browsing hypertext and multimedia - Using navigational tools - Using bookmarks and note taking - Graphical browsers, maps and overviews - Strategies for learning and re-learning - Self test 'CBT expert'.

Learning to Learn

Many authors suggest that deeper understanding means that sequential verbal information is highly interconnected with analog pictorial information (e.g. Mayer & Anderson, 1991, 1992). Supporting understanding, then, demands the construction of semantically connected pieces of text and pictures, activating

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appropriate pre-knowledge, providing learning strategies for multimedia, and changes of media and learning perspectives to support the construction of comprehensive mental models (Albrecht & O'Brian, 1993). Research (e.g. Mayer & Sims, 1994) support the consideration of individual differences in abilities and interests in order to enhance the understanding processes.

In two studies with 75 subjects we were able to confirm that individually adapted information enhances motivational and learning processes within computer-supported learning environments: Audio-visual media produced only a small effect, individual generated information, however, was very effective and was independent of subject variables like computer experience and usability judgements (Hasebrook & Gremm, in press).

Glowalla and Hasebrook (1995) conducted studies with 52 students which participated in a hypermedia learning course, all of them were novice hypermedia users. In the first lesson they are "unskilled learners", in the last lesson they were "skilled learners". Four month later, 43 of these students attended a relearning course. All students received exactly the same course materials and configuration of features of the hypermedia system as in the learning sessions. Therefore, in the first lesson they were skilled learners, but "unskilled relearners", and in the last lesson, they were "skilled relearners". The results show that browsing tools, such as paging and hypertext links, were used most frequently by skilled relearners, informational tools, such as a glossary and a keyword index, were used more often during learning than during relearning.

In conclusion, multimedia information is first encoded in simple text and image bases; using more sophisticated elaborating and inferencing processes mental models can be generated based on the information in the text and image bases (Hasebrook, 1999). Information selection and encoding from short term memory leads to separated encoding of verbal and pictorial information in the long term memory (Baddely, 1990; Paivio, 1986). There is a tendency to understand pictures 'at a glance' resulting in a simple representation that is not linked to verbal information (Weidenmann, 1994). Deeper processing of images can be elicited by teaching appropriate learning techniques (Drewniak, 1992) and by obvious links between pictures and ,verbal explanations. These higher levels of processing can help to generate appropriate static and dynamic mental models (Hegarty, 1992).

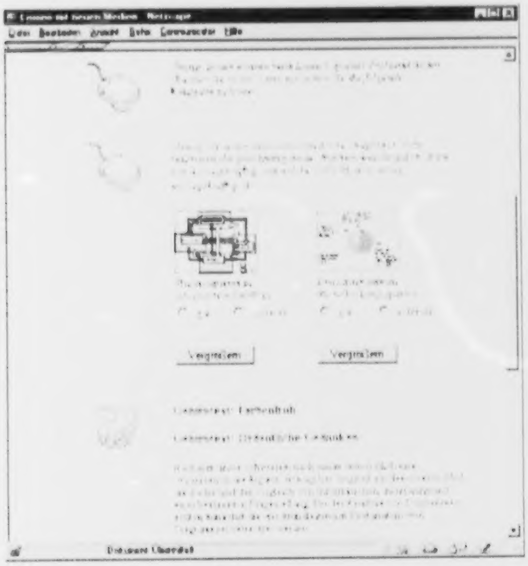

Figure 2: A content screen of the Web-based training course 'Learning in electronic media' provides brief explanations, interactive exercises (indicated by the mouse icon) and psychological self assessment (indicated by the brain icon).

The role of Meta-Cognition

Self-regulated learners govern a broad variety of cognitive and metacogntive strategies to fulfill their learning tasks. They monitor and - if necessary - modify their learning strategies. They are motivated, independent, and metacognitively active controllers of their own learning processes (Zimmermann, 1990). It is not easy to accquire knowledge about knowledge acquisition, but it is even more difficult to transfer this knowledge to every-day learning tasks. Therefore, it is essential to practice how to apply study techniques and to motivate the use of sometimes time consuming learning strategies. Otherwise, the learners most likely prefer simple study techniques, such as accessing all pages in sequential order.

Our aim is that is to use 'the computer as a tool for learning through reflection', as Collins and Brown (1988) put it. We tested the correlation of pre-knowledge and acceptance of software tools using an on-line expert system for vocational guidance. There is a positive correlation between the students' judgements about (1) how well the information provided by the system match their interests, (2) how well they know subject, (3) and how well they can imagine important aspects of the subject matter. However, there is a negative correlation between all these variables and the actual state of information: That is, the more information the students have got, the less they are willing to accept system advisory – and the less they have got a notion of knowing. Therefore, information leads to more skepticism and critics (Hasebrook & Nathusius, 1997).

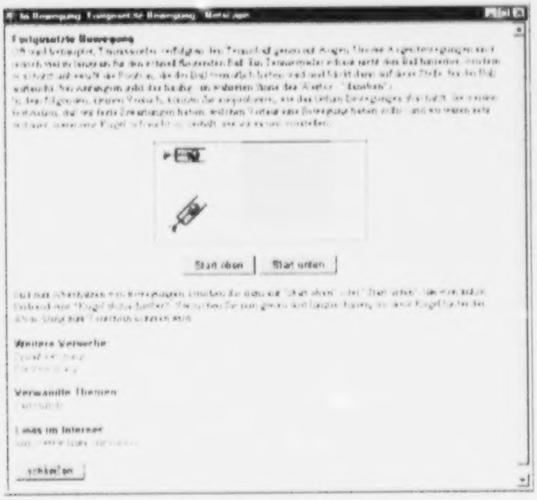

Figure 3: 'Brain tests' enable the user the participate in brief psychological self tests and learn about her or his perceptional and memory system; the screenshot depicts an experiment about the perception of movement.

In order to motivate users to apply learning strategies we integrated about fifty so called brain tests (cf. figure 3): Each brain test consists of short psychological experiments which can be easily conducted within a few seconds and illustrate important features of human perception and human memory. First experiences ascertained that it is amazing and highly motivating for students to test their own perceptions and learn about human cognition. The list of the brain tests comprises the following subjects: Specialization of the brain hemispheres - Grouping visual stimuli - Processing visual features (angles and distances) - Processing three-dimensional scenes - Perceiving colors - Perceiving movements - Acoustical illusions - Short-term and working memory - Memory sets and schemes - Cognitive illusions - Mood and memory - Social influences on cognition - Illusions of awareness and consciousness - (Very) long-term memory - Unconscious and implicit learning. Additionally, self tests for each module help the users to check their expertise on each topic and enables them to review directly the parts of the course which are linked to the questions.

Integrating Performance Support in Learning Systems

Web-based learning systems combine various advantages: access to huge amount of data, up-to-date information, and guidance provided by (self) tests and expert systems. This does not necessarily mean that students enjoy working with electronic media. This is the lesson we learned when comparing four media for vocational guidance (Hasebrook & Wagner, 1997): two of them are multimedia applications and the other two products are printed matter. We measured individual acceptance ratings after having used the four different products with 75 students participating in this study. The results show that printed matter are preferred. This result is statistically independent of sex, education, and experience in using a computer. Thus, the students enjoyed using electronic media, but they rely on printed matter.

Expert advice provided by the system, however, clearly increases acceptance and performance of electronic media: Users pick up more information and they consider this information to be more valuable. The more information they have gathered and elaborated the more they lose their notion of knowing and develop a critical

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approach to expert advisory. Multimedia applications should not be designed to provide "something for everyone", but they should provide exactly that piece of information which is needed in a particular stage of the decision making process. The effects were enhanced, if individual preferences were regarded.

A major German bank uses a special version of the PSS 'Learning in electronic media' as a kick-off course and motivational aid to introduce Web-based training in the bank. The aim of the PSS here is not to achieve predefined learning objectives but to avoid a 'learning culture shock' by helping the user to become a self-regulated learner. We aim to fully integrate the PSS as a background library and help system for any specific Web-based training course (cf. figure 4). Therefore, we develop an interface that uses keywords from the current HTML pages of the specific course and search terms entered by the user to search the glossary, the keyword and the full-text index of the PSS for relevant explanations and exercises.

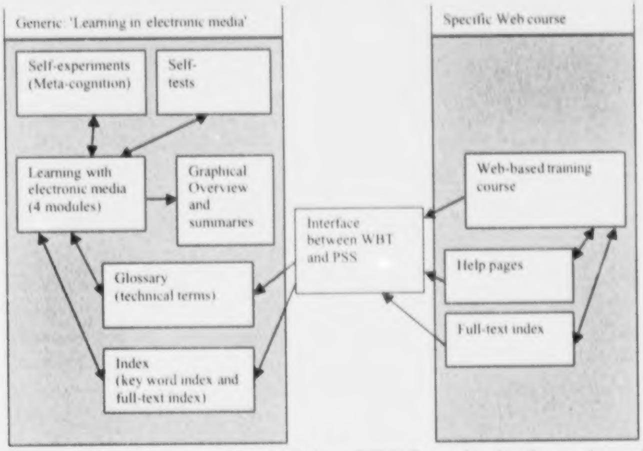
Generic: 'Learning in electronic media'
Self-experiments (Meta-cognition)
Self-tests
Learning with electronic media (4 modules)
Graphical Overview and summaries
Glossary (technical terms)
Index (key word index and full-text index)
Interface between WBT and PSS
Specific Web course
Web-based training course
Help pages
Full-text index

Figure 4: Architecture of the Web-based PSS 'Learning in electronic media' - generic topics and exercises can be linked to specific on-line courses by an interface using the search and the index facilities of the PSS.

The entire system can be stored on an ordinary 'open' Web server, such as Apache. New browser version allows for minor adaptations of colors and fonts using style sheets. Additionally, the system runs on a Hyperwave server which adapts the complete graphical user interface of the PSS to the user interface style of the target system: All buttons of the target system are active, styles guides concerning font, color, and navigational tools such as table of contents, are applied automatically. In this way the PSS becomes an integral part of any specific Web-based training course without re-implementing or modifying its contents.

Conclusion

The learning effect of multimedia has been disappointing, so far. This seems not to be based on a lack of computer literacy but on general deficits in media literacy and in learning strategies that support the integration of knowledge from different sources. Simple help pages are insufficient to cope with these deficits and to strengthen users' ability to become self-regulated learners. We therefore suggest to design and implement generic Web-based Performance Support Systems (PSS) that help the learner to understand and practice appropriate study techniques. Such an PSS has to enable the users to transfer the use of general learning strategies to their actual learning tasks - and it has to motivate this additional learning effort.

The PSS 'Learning in electronic media' comprises explanatory texts, pictures, and animations as well as interactive exercises, self tests, and brief psychological self experiments which give an vivid impression why and how elaborated learning strategies should be applied. Furthermore, the PSS discussed here can be integrated into specific Web-based courses by using style sheets, advanced Web servers, and an interface applet that browses the search facilities of the PSS and automatically points the user to appropriate information.

References

Albrecht, J.E., & O'Brien, E. (1993). Updating a mental model: Maintaining both local and global coherence. Journal of Experimental Psychology: Learning, Memory & Cognition, 19, 1061-1070.

Baddeley, A.D. (1990). Human memory. Theory and practice. Hillsdale, NJ: Lawrence Erlbaum.

Barba, R.H. (1993). The effects of embedding an instructional map in hypermedia courseware. *Journal of Research on Computing in Education, 4(25)*, 405-412.

Clancey, W.J. (1987). Methodology for building an intelligent tutoring system. In G.P. Kearsley (Ed.), *Artificial intelligence and instruction* (pp 193-227). Reading, MA: Addison-Wesley.

Clark, R.E., & Craig, T.G. (1992). Research and theory on multi-media learning effects. In M. Giardina (Ed.), *Interactive multimedia learning environments. Human factors and technical considerations on design issues* (pp. 19-30). Heidelberg: Springer.

Collins, A., & Brown, J.S. (1988). The computer as a tool for learning through reflection. In H. Mandl & A. Lesgold (Eds.), *Learning issues for intelligent tutoring systems* (pp. 1-18). Heidelberg: Springer.

Cox, R., & Brna, P. (1995). Supporting the use of external representations in problem solving: The need for flexible learning environments. *Journal of Artificial Intelligence in Education, 6(2/3)*, 239-302.

Drewniak, U. (1992). *Lernen mit Bildern in Texten. Untersuchung zur Optimierung des Lernerfolgs bei Benutzung computerpräsentierter Texte und Bilder.* Münster: Waxmann.

Duchastel (1992). Towards methodologies for building knowledge-based instructional systems. *Instructional Science, 20(5/6)*, 349-358.

Glowalla, U. & Hasebrook, J. (1995). An evaluation model based on experimental methods applied to the design of hypermedia user interfaces. In Schuler, W., Hannemann. J. & Streitz, N.A. (Eds.). Hypermedia user interface design. New York: Springer.

Hasebrook, J. (1999). Searching the Web without losing the mind - traveling the knowledge space. WebNet Journal, 1(2), 24-32.

Hasebrook, J. (1995). Lernen mit Multimedia (Learning with multimedia). *German Journal of Educational Psychology, 9(2)*, 95-103.

Hasebrook, J., & Nathusius, W. (1997). An expert advisor for vocational guidance. Journal of Artificial Intelligence in Education. 8(1), 21-41.

Hasebrook, J., & Wagner, J. (1997). Subjektive Bewertung von gedruckten und elektronischen Medien zur Berufsorientierung. Medienpsychologie, 9(2), 89-104.

Hasebrook, J., & Gremm, M. (in press). Multimedia for vocational guidance: Effects of individualized testing, videos, and photography on acceptance and recall. *Journal of Educational Multimedia and Hypermedia.*

Hegarty, M. (1992). Mental animation: Inferring motion from static displays of mechanical systems. Journal of Experimental Psychology: Learning, Memory, and Cognition, 18(3), 1084-1102.

Kulik, C.-L., & Kulik, J.A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior, 7*, 75-94.

Larkin, J.H., & Chabay, R.W. (Eds.) (1992). *Computer assisted instruction and intelligent tutoring systems: Shared goals and complementary approaches.* Hillsdale, NJ: Erlbaum.

Maurer, H. (1998). Using the WWW System Hyperwave as the Basis of a General Networked Teaching and Learning Environment, CIT, 6(1).

Mayer, R.E., & Anderson, R.B (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology, 83(4)*, 484-490.

Mayer, R.E., & Anderson, R.B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology, 84(4)*, 444-452.

Mayer, R.E., & Sims, V.K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia. *Journal of Educational Psychology, 86(3)*, 389-401.

McGraw, K.L. (1994). Performance support systems: Integrating AI, hypermedia, and CBT to enhance user performance. *Journal of Artificial Intelligence in Education, 5(1)*, 3-26.

Paivio, A. (1986). *Mental representations: A dual-coding approach.* New York, Oxford: Oxford University Press.

Schulmeister, R. (1996). *Grundlagen hypermedialer Lernsysteme. Theorie, Didaktik, Design.* Bonn: Addison-Wesley.

Self, J. (1992). Unrevealing the learner model mystery. In F.L. Engel & D.G. Bouwhuis (Eds.), *Cognitive modeling and interactive environments in language learning* (pp 17-25). Heidelberg: Springer.

Software Publishers Association (1995). *Report on the effectiveness of technology in schools, 1990-1994.* Washington, DC: SPA.

Van den Berg, S., & Watt, J.H. (1991). Effects of educational setting on student responses to structured hypertext. *Journal of Computer-Based Instruction, 4(18)*, 118-124.

Weidenmann, B. (1994). Wissenserwerb mit Bildern. Bern: Hans Huber.

Zimmermann, B. (1990). Self-regulated learning and academic achievement: An overview. Educational Psychologist, 25, 3-17.

The HC-Data Model: A New Semantic Hypermedia Data Model

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Abstract: In this paper we present the current situation at the field of hypermedia data modelling. We list advantages and disadvantages of the most primitive hypermedia data model, i.e. the node-link data model and the models of the second generation hypermedia, such as the Hyperwave data model and HM-Data Model. We believe that an introduction of a semantic hypermedia data model, called the HC-Data Model can solve a number of problems in modern hypermedia data modelling. Thus, we give a formal definition of the HC-Data Model. At the end we in short present Structure Editor, an application that supports the HC-Data Model.

1. Introduction

Hypermedia combines the words "hypertext" and "multimedia".

The hypertext technology allows users a non-linear access to information, contained in a collection of textual documents. Hypertext introduces the term of a hyperlink. A hyperlink connects two related documents. Users can follow a hyperlink and in this way jump from the document they currently read to a related document [Maurer et al. 1998].

While hypertext uses only textual documents to present information, multimedia offers a possibility to use other forms of information. One may incorporate graphics, pictures, sounds, animation, video and combine them to a single multimedia document [Maurer et al. 1996].

Hypermedia combines these two technologies into one new. It is based on the hypertext technology, in the sense that it connects documents via associative links, but in the opposite to hypertext, each document is a multimedia document and can have a number of different media objects [Maurer et al. 1998]. Hypermedia imposes a particular structure on the top of a number of multimedia documents. This structure is defined by a particular hypermedia data model that a hypermedia system utilizes.

The most popular hypermedia system today is the World Wide Web a global, distributed hypermedia database. The WWW utilizes the so-called node-link data model. In this model, a particular multimedia document is seen as a node and relations between nodes are denoted as links. Links are always directed, i.e. there is a source document and there is a destination document. Links are embedded into nodes, that is each link is a part of the document definition and is stored in the database as such.

There is a number of problems connected to the use of the node-link data model:

- editing of links is tedious
- logical integrity is not supported
- links are not context-dependent
- the presence of links unrelated to the current context leads to reader disorientation

- the reuse of hypermedia materials is unsatisfactory

WWW is based on a typical client-server architecture. Hypermedia documents are stored as HTML pages on the server side and accessed by clients using a standard Web browser.

HTML (HyperText Mark-up Language) is a mark-up language that gives instruction to the Web browser how to render documents on the users screen. It uses different mark-up tags to embed different types of media objects, such as pictures, video, animation, etc. Further, it allows embedding of pointers to other documents that are used as hyperlinks. Thus, HTML implements the node-link data model and in this way inherits its disadvantages. Therefore, the use of another logical data model, that offers different structuring mechanisms for hundreds of hypermedia documents have been already seriously considered.

The second generation hypermedia data models, such as the Hyperwave data model [Maurer 1996] or the HM-Data model [Maurer et al. 1996] have been introduced and applied on the WWW. These data models utilize so-called hypermedia-composites. A hypermedia composite represents a closed collection of hypermedia documents that has some internal link structure, which may be created automatically and which ensures the integrity of the database. Furthemore, the link consistency as a specific property of hypermedia systems is also guaranteed by the second generation hypermedia data models.

Although the second generation hypermedia data models solve the problems of the node-link data model their usage has also a number of disadvantages, such as:

- there is a need to learn how to use a new logical data model (this might last a long time)
- it is difficult to use a logical data model in a big number of different applications (most of them are adjusted to some specific type of hypermedia applications).

Thus, as we can see, the introduction of new logical data models to the WWW brought a number of new problems [Helic et al. 1999]. Therefore, int his paper we propose a new semantic data model – the HC-Data Model – and we believe that its use can reduce the time for learning the model as well as provide a great flexibility to use the model in a number of different applications. Thus, we beleive that the HC-Data model can solve the problems of the second generation hypermedia data models.

2. HC-Data Model

HC-Data Model is a semantic hypermedia data model that operates on HC-Units and HC-Types. The prefix HC here stands for Hypermedia Composite. A semantic hypermedia data model models the hypermedia information as an abstract entity with a number of specific characteristics. For example, the HC-Data model would comprehend a person as an abstract data object *Person* that has hypermedia documents containing a *biography*, a *picture* and a description of *current work* as its properties. An abstract entity *Person* that has a *name*, an *age* and a *profession* can be considered to be an abstract data type, and a *person* with the *name Nick*, the *age 45* and the *profession Scientist* can be seen as an instance of the abstract data type *Person*. In the HC-Data Model an HC-Type is an abstract data type definition and an HC-Unit is an instance of an HC-Type.

The HC-Data Model extends the concept of the hypermedia composite with the possibility to define new types of hypermedia composites. This is done via the concept of an HC-Type which is an abstract data type definition or we can say a meta-definition of a class of hypermedia composites. Instances of an HC-Type are called HC-Units of this type. The HC-Data Model sees a hypermedia composite as an abstract data entity that has a number of characteristics. These characteristics are determined by an abstract data type definition, i.e. by an HC-Type.

An HC-Type defines characteristics of hypermedia composites and their members, i.e. it defines a number of meta-information attributes which will be attached to instances of that HC-Type, i.e. HC-Units and their members. The meta-information attributes appear in the form of key-value pairs. Some of these attributes are fully defined, that is to say both, the key and the value, are specified in an HC-Type. For some of these meta-information attributes only the name of the key is defined whereas the value will be entered when manipulating an HC-Unit of that HC-Type. We can classify those meta-information attributes into two groups:

- meta-information attributes of a hypermedia composite
- meta-information attributes of members of a hypermedia composite

A correct definition of a hypermedia composite type, that is a correct HC-Type has to define the following attributes from the first group:

- *CompositeType* attribute with an assigned value
- *CompositeAccessView* attribute with an assigned value
- *CompositeURL* attribute without a value.

From the second group an HC-Type has to include the definition of at least one member of that HC-

Type (but can and probably will have the definition of a number of different members). This definition includes following meta-information attributes:

- *MemberRole* attribute with an assigned value
- *MemberPosition* attribute without a value
- *MemberURL* attribute without a value.

Additional attributes can also be defined for both hypermedia composites and/or their members with or without assigned values.

For example an abstract data object *Person* that we already mentioned, defined as an HC-Type, would have following attributes:

- CompositeType attribute with the value Person
- CompositeAccessView attribute with the value file://c:/composites/person.view
- *CompositeURL* attribute without a value

The "Person" HC-Type would have three different members with following attributes:

- First Member:
  - *MemberRole* attribute with the value *Biography*
  - *MemberPosition* attribute without a value
  - *MemberURL* attribute without a value
- Second member:
  - *MemberRole* attribute with the value *Picture*
  - *MemberPosition* attribute without a value
  - *MemberURL* attribute without a value
- Third member:
  - *MemberRole* attribute with the value *CurrentWork*
  - *MemberPosition* attribute without a value
  - *MemberURL* attribute without a value.

Furthermore, an HC-Type offers a public interface to manipulate the content of an instance private memory. This public interface includes following methods:

- public void add(String member_role, URL url);
- public void replace(String member_role, URL url);
- public void insert(String member_role, int member_position, URL url);
- public void delete(String member_role, int member_position);
- public CompositeAccessView access();

The *add()* method adds a member, which might be a hypermedia document or an HC-Unit, to an HC-Unit giving it the specified *MemberRole* attribute.

The *replace()* method is used when a member should get the specified *MemberRole* attribute and replace a member currently having this *MemeberRole* attribute.

The *insert()* method is used when a member has to be inserted in a list of members having the specified *MemberRole* attribute exactly on the specified position

The URL argument of these three methods specifies an address of a hypermedia document or an HC-Unit on the Internet or a local file system. It is used by the access method in order to visualise an HC-Unit properly.

The *delete()* method deletes a specified member from an HC-Unit.

The *access()* method is used in order to visualise an HC-Unit following to the definition given in a special file (this file is specified through the "CompositeAccessView" attribute of an HC-Type) by using the existing hypermedia documents and/or existing HC-Units located by the "MemberURL" attributes.

3. Visualisation of an HC-Type

An HC-Type provides the *access()* method in its public interface. The *access()* method is called whenever an HC-Unit of that HC-Type is accessed in the sense of browsing the hypermedia information that the accessed HC-Unit contains. The CompositeAccessView attribute of an HC-Type has as its value a URL of a file defining the visualisation mechanism for the particular HC-Type. When the *access()* method of an HC-Unit is called for the first time the definition file is interpreted and a number of visualisation objects is instantiated. These visualisation objects become part of the HC-Unit private memory and are responsible for the proper visualisation of the particular HC-Unit. They also provide a user interface for retrieving the hypermedia information, i.e. for browsing the content of an HC-Unit.

The most important visualisation object is called *ScreenTemplate*. A *ScreenTemplate* is a rectangular area representing a canvas for visualising an HC-Unit. This canvas is split into a number of rectangles which do not intersect with each other and whose union is equal to the starting rectangular area of the particular screen template. We will call these rectangles screen template cells or just cells. Each screen template cell has a so-called *PlaceHolder* visualisation object as its child. A *PlaceHolder* object is an object that presents a piece of information from a particular HC-Unit as a valid HTML text. In this way a *ScreenTemplate* is composed as a valid HTML document and consequently rendered in a standard Web browser.

An HC-Type defines a number of *ScreenTemplate* objects having one of these *ScreenTemplate* objects is defined as the starting template, i.e. it will be shown whenever the *access()* method of the particular HC-Unit is called. A user will activate computer-navigable links in order to access other *ScreenTemplate* objects. As a result of accessing another *ScreenTemplate* object the starting one will be removed and the content of the accessed one will be rendered.

Let us now classify *PlaceHolder* objects. There are three different groups of *PlaceHolder* objects:

- *PlaceHolder* objects with a fixed content
- *PlaceHolder* objects with a dynamic content
- *PlaceHolder* objects representing computer-navigable links

PlaceHolder objects with a fixed content are the *TextPlaceHolder* object and the *ImagePlaceHolder* object.

The *TextPlaceHolder* object has a piece of plain or HTML text as its information source. This fixed text that a *TextPlaceHolder* object holds is presented in a screen template cell of this object.

Similarly, an *ImagePlaceHolder* object has as its content a fixed picture which is shown in the screen template cell that this object occupies.

PlaceHolder objects with a dynamic content can be the *MemberPlaceHolder* object or the *AttributePlaceHolder* object.

A *MemberPlaceHolder* object has a member of an HC-Unit as the information source. The member is strictly defined through the *MemberRole* meta-information attribute, which means that a *MemberPlaceHolder* object holds the place for a member with the specified value of the *MemberRole* attribute. For instance in the HC-Type *Person* we will have a *MemberPlaceHolder* that holds the place for a member that has *Biography* as the value of the *MemberRole* attribute. Using the *MemberURL* attribute of a member the actual content of this member will be rendered in the screen template cell of the particular *MemberPlaceHolder*. If a number of members has the same *MemberRole* attribute, i.e. if an HC-Unit has a list of members of a particular *MemberRole* attribute then the value of the *MemberPosition* attribute is used to uniquely address a particular member. The value of the *MemberPosition* attribute in a *MemberPlaceHolder* may be altered, i.e. it can be incremented or decremented. In other words an user can navigate through the list of members having the same value of a *MemberRole* attribute. This navigation occurs also as a result of following computer-navigable links defined through a special kind of *PlaceHolder* objects representing hyperlinks.

In the same way as a *MemberPlaceHolder* object an *AttributePlaceHolder* object uses a value of a *MemberRole* and a *MemberPosition* attribute to point out a member of an HC-Unit, but while a *MemberPlaceHolder* object uses the *MemberURL* attribute of the particular member an *AttributePlaceHolder* uses a name of some other attribute of the particular member in order to display the value of this attribute. If the *MemberRole* attribute of an *AttributePlaceHolder* object has a list of members *PlaceHolder* objects representing computer-navigable links can be used in order to navigate through the member list.

PlaceHolder objects representing computer-navigable links are not a special group of *PlaceHolder* objects but a *TextPlaceHolder* object, an *ImagePlaceHolder* object or an *AttributePlaceHolder* object can be defined to be a hyperlink as well. We will call these objects *LinkPlaceHolder* objects. For example the functionality of a *TextPlaceHolder* object can be extended to the functionality of a *LinkPlaceHolder* object of type *TextPlaceHolder*, which means that the text of a *TextPlaceHolder* has been put inside an HREF tag. The destination document of a *LinkPlaceHolder* object can be another *ScreenTemplate* object of that HC-Type or the same *ScreenTemplate* object with altered values of the *MemberPosition* attributes of *MemberPlaceHolder* or *AttributePlaceHolder* objects. In this way browsing of an HC-Unit is carried on.

For instance our HC-Type *Person* can be defined to have two *ScreenTemplate* objects:

- A *ScreenTemplate* object called *access* defined as the starting one
- A *ScreenTemplate* object called *current_work*

The *access ScreenTemplate* object has three *PlaceHolders* as follows:

- A *MemberPlaceHolder* object called *biography* that holds a member with the *MemberRole* attribute of the value *Biography*

- A *MemberPlaceHolder* object called *picture* that holds a member with the *MemberRole* attribute of the value *Picture*
- A *TextPlaceHolder* object called *current_work_link* that holds a fixed text (e.g. See my current work) and that is defined as a *LinkPlaceHolder* object which replaces the *access ScreenTemplate* object with the *current_work ScreenTemplate* object.
  The *current_work ScreenTemplate* object has two *PlaceHolders* as follows:
- A *MemberPlaceHolder* object called *current_work_member* that holds a member with the *MemberRole* attribute of the value *CurrentWork*
- A *TextPlaceHolder* object called *go_back_link* that holds a fixed text (e.g. Go back) and that is defined as a *LinkPlaceHolder* object which replaces the *current_work ScreenTemplate* object with the *access ScreenTemplate* object.

4. Implementation of HC-Data Model

The Structure Editor presented in the following chapter is a system that supports and implements the HC-Data Model. It consists of three components:

- Structure Editor Visual Definition Tool
- Structure Editor Visual Manipulation Tool
- Structure Editor Java Visualisation Interpreter

With the help of the Structure Editor Visual Definition Tool a new HC-Type can be defined. The tool offers a graphical user interface with drag and drop facilities. Authors first define a new abstract entity by specifying its meta-information attributes and finally they define a visualisation mechanism by defining a number of ScreenTemplate objects with corresponding PlaceHolder objects.

The newly defined type, HC-Type, is then used by the Structure Editor Visual Manipulation Tool in order to create instances of the HC-Type, i.e. HC-Units – collections of existing hypermedia documents and/or other HC-Units. This tool also offers an easy-to-use graphic user interface again with drag and drop facilities. Hypermedia documents are then simply dragged from a tree-like structure, which can be browsed using the Windows Explorer paradigm, to the right place in an HC-Unit. Hypermedia information can be accessed from any kind of information source, such as a Hyperwave information server, an HTTP server, an FTP server or a local file system. This is done through so-called ANT (Active Node Technology) [4] which allows a fully transparent access to any kind of information stored on any type of information server (see fig. 1.).

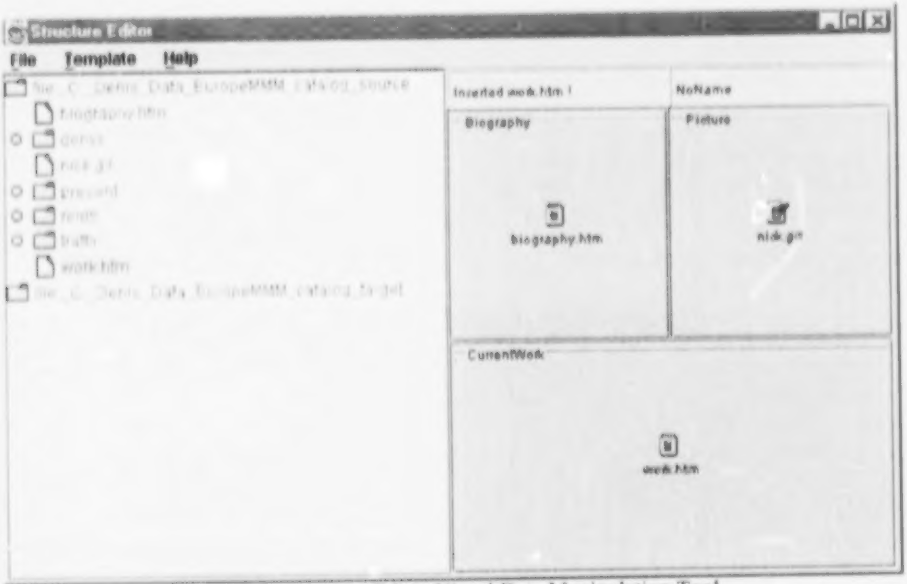

Figure 1: Structure Editor Visual Data Manipulation Tool

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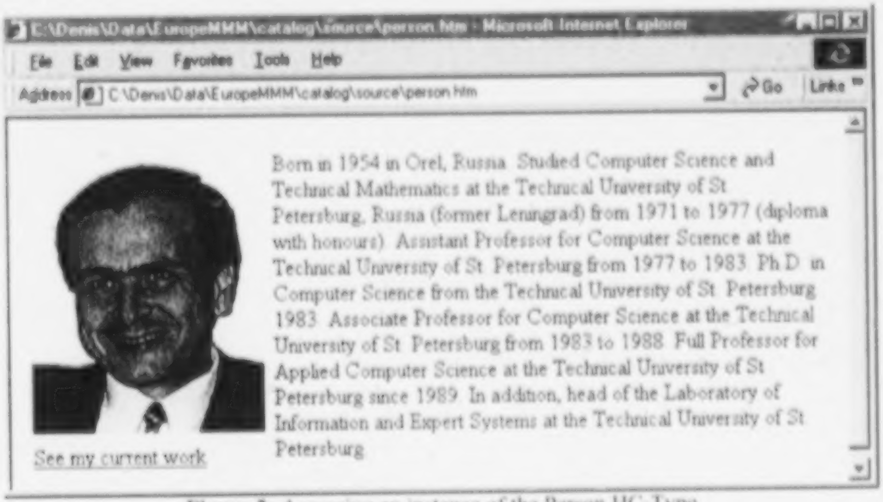
Once an HC-Unit has been created it can be published on a Web information server or a local file system. It can then be accessed by any standard Web browser, such as Netscape Navigator or Microsoft Internet Explorer. The visualisation is performed by the definition of the corresponding HC-Type and controlled by the third Structure Editor component, the Structure Editor Java Visualisation Interpreter (see Fig. 2.). This interpreter is implemented as a Java applet and is embedded in the starting page of the HC-Unit created.


C:\Denis\Data\EuropeMMM\catalog\source\person.htm - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address C:\Denis\Data\EuropeMMM\catalog\source\person.htm
Go
Links
See my current work

Born in 1954 in Orel, Russia. Studied Computer Science and Technical Mathematics at the Technical University of St. Petersburg, Russia (former Leningrad) from 1971 to 1977 (diploma with honours). Assistant Professor for Computer Science at the Technical University of St. Petersburg from 1977 to 1983. Ph.D. in Computer Science from the Technical University of St. Petersburg 1983. Associate Professor for Computer Science at the Technical University of St. Petersburg from 1983 to 1988. Full Professor for Applied Computer Science at the Technical University of St. Petersburg since 1989. In addition, head of the Laboratory of Information and Expert Systems at the Technical University of St. Petersburg.

Figure 2: Accessing an instance of the Person HC-Type

5. Conclusion

In conclusion, we would like to notice that the proposed HC-Data Model as a semantic hypermedia model that extends the possibilities of the object-oriented hypermedia data models, such as the Hyperwave data model or the HM-Data Model, can have even bigger possibilities if used in a combination with some of these models. Mapping of the HC-Data Model to the Hyperwave data model is a good example of this combined use and is described in [Helic et al. 1999a]. Even mapping of the HC-Data Model to the node-link data model is possible and needed because of a big number of standard HTTP servers installed world-wide. But the most interesting application of the HC-Data Model would be, as we truly believe, mapping of the HC-Data Model onto XML. Similar to the HC-Data Model XML technology [Microsoft Corp. Homepage 1998][WWW Consortium 1998] allows authors to define new types of hypermedia constructs, i.e. the structure of hypermedia databases, as well as the navigational and visualisation paradigm. Because XML already becomes a standard the combination of the HC-Data Model and XML technology can offer the best possibilities for creating highly structured hypermedia applications.

6. References

1. Hermann Maurer (1996), *Hyperwave - The Next Generation Web Solution*, Addison-Wesley
2. Denis Helic, Hermann Maurer, Nick Sherbakov (1999), Authoring and Maintaining of Educational Applications on the Web, *EDMEDIA 99*
3. Denis Helic, Seid Maglajlic, Nick Sherbakov (1999), Educational Materials on the Web: Data Modelling Approach, *MIPRO 99*
4. D. Freismuth, K. Schmaranz, B. Zwantschko (1998), Telematic Platform for Patient Oriented Services, *JUCS, vol. 11, 1998*
5. H. Maurer, N. Scherbakov, Z. Halim, Z. Razak (1998), *From Databases to Hypermedia*, Springer
6. H. Maurer, N. Scherbakov (1996), *Multimedia Authoring for Presentation and Education*, Addison-Wesley
7. Microsoft Online XML Workshop, http://www.microsoft.com/xml, *Microsoft Corp. Homepage*
8. Extensible Markup Language (XML™), http://www.w3.org/XML/, *World Wide Web Consortium*

Linking XML and Databases

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Abstract: Extensible Markup Language (XML) is becoming a standard format for exchanging documents and data. Various middleware tools that integrate different data sources and make them available over the Web will use XML as a standardized interchange format for data and meta-data. In this paper we describe a XML schema language that describes data sources and allows XML documents to be generated from their data. It allows us to flexibly bind databases and other data sources to XML. The objective is to obtain a flexible, component-based distributed information system architecture that integrates with the World-Wide Web and other XML-aware software tools.

1. Introduction

Extensible Markup language (XML) [W3C 1998] is fast becoming a standard format for exchanging documents and data. XML basically defines and exchanges data structures. This makes it a good format for information integration middleware tools. A typical application is publishing (heterogeneous) databases on the Web. Microsoft alone has at least five tools that allow this, and there must be hundreds of others. These tools all use different languages and formats, making it difficult to change or combine these tools.

A possible solution may come from XML schemas that will allow binding between XML and external data sources to be defined. An *XML schema* is an XML document that formally defines an XML document type [W3C 1999]. In addition a schema may contain additional information about the documents it describes, such as:

- **Data types:** XML defines all values as text, although some values represent numbers, dates or colors. An XML schema should specify specific data types, and a text encoding for each type.
- **Constraints:** XML parsers only check for uniqueness of identifiers and validity of references. An XML schema will allow additional constraints on values and references.
- **Documentation:** In an XML DTD documentation can only be inserted in the form of comments. An XML schema should allow (even require) text to be inserted to document the elements and attributes in it.
- **Binding:** An XML schema may formally describe how the information in XML files is related to a relational database or any other external data source.

The World-Wide Web Consortium will define standard syntax or semantics for XML schemas. The XML-Data schema submitted by Microsoft [Microsoft 1998] is aimed at the integration of XML with relational database and other data sources.

In this paper we will describe a practical system that links XML and heterogeneous external data sources, using an XML schema language.

2. Architectures for Distributed Information Systems

Architectures for distributed information systems have become more and more advanced in order to allow more flexibility. The main problem is not in creating a working system, but rather in allowing a system to gradually adapt to changing requirements. In this section we describe the currently used architectures and show how these will naturally evolve to a more flexible one that uses XML schemas to separate clients from servers, and servers from the underlying databases.

In a two-tier client-server system, client programs interact directly with the database. The obvious disadvantage of this approach is that clients are very tightly coupled with the database. This makes it difficult to change the system's architecture, the database structure or even change database vendor. With the appearance of Web applets and JDBC, this architecture has become more attractive, because the applet code is downloaded from the server, making it easier to manage change.

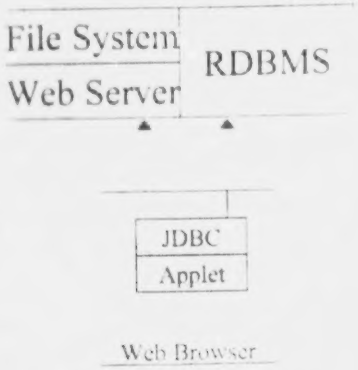

***Figure 1**: Two-Tier Architecture*

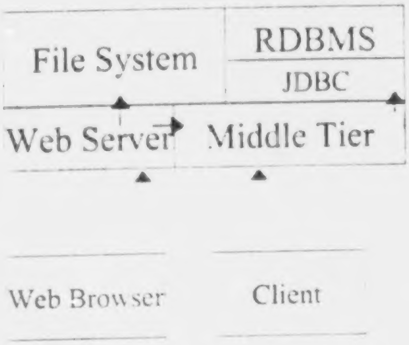

***Figure 2**: A Common Web-integrated Three-tier Architecture*

The two-tier architecture is limited because the client-to-server communication is limited to the database protocol. Also, it is impossible to integrate the application with data sources outside of the database. In a three-tier architecture, a layer is introduced that separates the client from the database. All communication between client and server is routed through this middle tier. When such an application is integrated with a Web server, we get the architecture shown in Figure 2.

3. A Flexible Component-Based Architecture

We want to develop a client-server architecture that allows even more flexibility than the three-tier architecture. We propose to use a component-based architecture that relies solely on XML as an interchange protocol. The components are objects that translate from some data source to XML and back.

The main components are objects called *XML Schemas* that are capable of creating and parsing XML elements. They are adapters that convert the interface of some database to the more general XML Document Object Model (DOM) interface [W3C 1998b].

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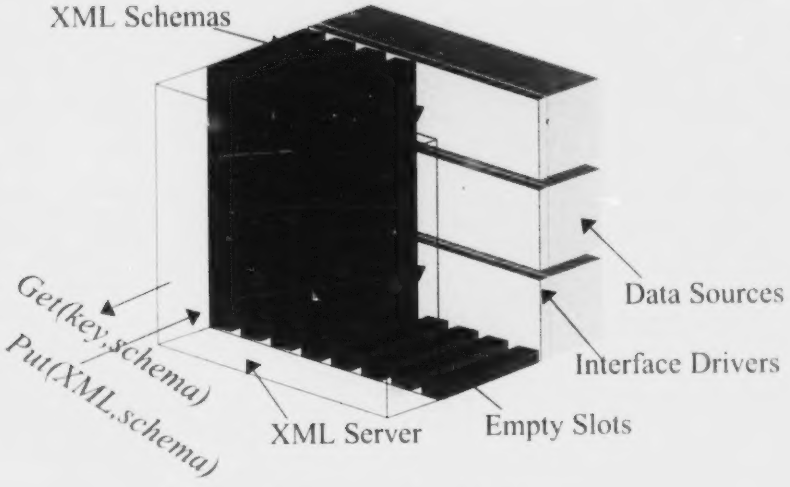

***Figure 3**: Component-Based Architecture*

Figure 3 shows the proposed component-based architecture. At the front is an XML server that operates much like a current Web server. It is given a key that identifies some information resource, and an identifier for an XML schema. From this the server generates a reply, which is an XML file. The XML schema driver is an object that is able to extract information from the underlying data sources and convert it to the appropriate XML DTD. Some schemas are able perform the reverse operation - they can parse an XML file and update the underlying database to reflect the information in that XML file.

The XML document may be delivered with a stylesheet to render it in a Web browser. If the browser does not support XML and stylesheets, an HTML document can be generated.

The schemas can be linked to different data sources such as a relational database, an object oriented database or a file system through a layer of interface drivers. By adding a new driver, a new class of data source can be used. Also, multiple schemas may interact with the same data.

In short, the advantages of the proposed approach are:

- Clients use a standardized and uniform interface (DOM or XML) to different data sources.
- Clients are independent of the data source.
- It allows multiple mappings or views of underlying data.

4. The Schema Language

We have developed a schema language, based on the XML-Data schema specification, to represent the schema objects in XML. We have extended the existing language with constructs that express the binding between XML elements and a database. This binding is based on the relational data model [Codd 1970], which is obviously well-suited to relational data bases, but does not necessarily exclude object oriented databases or flat files.

A schema contains zero or more bindings and one or more `elementTypes`. A binding defines a number of `drivers` and `tables`. A `driver` is identified using a `URL` such as a JDBC URL. For each table a number of keys and foreign keys is defined. Since a query, as defined in SQL, can be regarded as a virtual table, with a key and foreign keys, it is quite easy to integrate queries as well.

```
<Schema id="company">
<Driver id="oracle" url="jdbc:thin:oracle"/>
<Driver id="fileurl" url="file:///pictures/"/>
<Table id="employee" driver="oracle">
  <Key id="ssn"><column name="ssn"/></Key>
  <ForeignKey id="superssn" key="ssn">
    <column name="superssn"/>
  </ForeignKey>
<ForeignKey id="picture" key="filename">
    <column name="pict"/>
  </ForeignKey>
</Table>
<Table id="department" driver="oracle">
  <Key id="dnumber"><column name="dnumber"/></Key>
  <Key id="dname"><column name="dname"/></Key>
  <ForeignKey id="superssn" key="ssn">
    <column name="superssn"/>
  </ForeignKey>
</Table>
<Table id="pictures" driver="fileurl"/>
  <Key id="filename"><column name="fname"/></Key>
</Table>
```

4.1. Example

The example schema on the left describes a relational database, which stores information about employees and departments. Employees are identified by their social security number (`ssn`), departments by their number (`dnumber`) or their name (`dname`). A department has a foreign key to its manager's social security number. An employee can have a foreign key reference to his supervisor (`superssn`). We also keep pictures of employees, which are not stored in the database itself. The schema offers a way to integrate both data sources: we define a (virtual) table consisting of the picture files. A special database driver offers access to binary files stored in a directory of the file system. Employees whose pictures are available have a database field `pict` which stores the filename. This is, in a way, a foreign key to the (virtual) table holding the files.

```
<elementType id="employee" key="ssn">
  <attribute name="ssn" dt="string"/>
  <attribute name="first-name" column="fname"
    dt="string"/>
  <attribute name="last-name" column="lname"
    dt="string"/>
  <attribute name="birth-date" column="bdate"
    dt="date.iso8601"/>
  <attribute name="salary" dt="float"/>
  <element type="picture"
   occurs="OPTIONAL" foreignKey="picture"/>
  <element type="department-short"
   occurs="REQUIRED" foreignKey="dno"/>
</elementType>
<elementType id="employee-short" key="ssn">
  <string column="lname"/>
</elementType>
<elementType id="picture">
  <string dt="base64"/>
</elementType>
<elementType id="department" key="dno">
  <attribute name="name" column="dname"/>
  <element type="employee-short"
   occurs="ZEROORMORE" foreignKey="dno"/>
</elementType>
<elementType id="department-short" key="dno">
  <string column="dname"/>
</elementType>
```

The second part defines how the database tuples are represented in XML. Basically a row from the database is represented as one XML element, in which possible related rows are embedded as nested XML elements. Database rows are mapped to XML tag attributes or text, using format specifiers for dates (e.g. date.iso8601) and numbers. The element types in fact represent textual tree-like views of related data in the database.

5. Update Semantics

The views that these element types represent have the following simplified update semantics: there are only two operations: GET and STORE. This first generates an XML file from the database; the second updates the database so that a subsequent GET would generate the provided XML file:

- If a root element (one that has a key) is stored, it is updated or inserted, depending on whether a tuple with the specified value for its keys already exists or not. Related tuples that have no corresponding child element in the XML are removed from the database.
- Values of key attributes are never updated. A new tuple must be inserted.

Because there is no explicit delete operation, it may be necessary to use some kind of garbage collection algorithm to remove superfluous tuples from the database.

6. Current Status and Future Work

Our current implementation uses a two step process to generate XML:

- First a simple XML representation of the database tuples is generated. Each column is translated to an attribute of an XML element, using a format specifier. These attributes have the same name as the column, but they can be given an alias to allow a column to be represented twice, but with a different format.
- Then this XML is converted to the desired DTD using a XSL style sheet.

A second XSL style sheet is required to convert posted XML documents into the base DTD that can be mapped to the database so it can be stored. The disadvantage of this approach is that two stylesheets are required that must do inverse tree transforms. But it does avoid the problem of having to guarantee that the transformation implicit in the schema can be inverted. This problem is presumably equivalent to the problem of view updateability in relational databases and is worth further investigation.

Other XML schema languages are being developed, like e.g. DDML [W3C 1999b] that is now accepted as a W3C submission. It uses a simpler model and more extensible model than XML-Data and has a good chance of wide acceptance. DDML will also have a vocabulary for encoding it in RDF, W3C's resource description framework.

This work is inspired by our involvement in the ARIADNE project. For the ARIADNE[2](http://ariadne.unil.ch) (Alliance for Remote Instructional Authoring and Distribution Networks for Europe) project, we have developed a system for distributing information about educational resources on the Internet [Forte 1997]. It uses XML to exchange metadata between the so-called *Knowledge Pools* and client tools. Each knowledge pool stores various resources, some of which are encoded in XML, and makes them available to users. The system uses a relational database to store metadata so it can be queried. Some of the information is replicated among different knowledge pools. The greatest challenge is to design the system so that it remains possible to evolve the metadata structure. Other requirements are:

- Sites must be able to integrate their Knowledge Pool with their own information systems and databases.
- Some sites want to be able to extend the metadata structure but still be able to interoperate with other sites.
- We want to be able to convert to the international standard for educational metadata, which is currently being defined by the IEEE Learning Technology Standards Committee.

7. Conclusion

To better integrate distributed information systems with existing databases, and to better separate the representation of information from the underlying data structures, we have defined a component-based information system architecture. We have defined a meta-schema to bind different information resources to XML files. Such a meta-schema has the potential of being a single unifying view of data. It allows us to create applications without worrying about how this data is stored, by providing a more flexible but standardized interface.

8. References

[Cardinaels 1998] Cardinaels, K.& Hendrikx, K. & Vervaet, E. & Duval, E. & Olivie, H. & Haenni, F. & Warkentyne, K. & Wentland-Forte, M. & Forte, E. (1998). A Knowledge Pool system of Reusable Pedagogical Elements, *Computer Aided Learning and Instruction in Science and Engineering.*

[Cardinaels 1998b] Cardinaels, K. & Duval, E. & Olivié, H. (1998). High-level database document specification using XML, *Webnet 1998*, Association for the Advancement of Computing in Education, .

[Codd 1970] Codd, E. (1970). *A Relational Model for Large Shared Data Banks*, CACM, 13:6, June 1970.

[Forte 1997] Forte, E.N. & Wentland Forte, M.H.K. & Duval, E. (1997). *The Ariadne Project (Part I): Knowledge pools for computer-based and telematics-supported classical, open and distance* *education*, European Journal of Engineering Education, 22, pp 61-74.

[Microsoft 1998] Microsoft Corp, (1998). *XML Data specification*, http://www.microsoft.com/standards/xml/xmldata.htm

[W3C 1998] The World-Wide Web Consortium (1998). *Extensible Markup Language (XML) 1.0*, http://www.w3.org/TR/1998/REC-xml-19980210, W3C Recommendation 1 October, 1998

[W3C 1999] The World-Wide Web Consortium (1999). *XML Schema Requirements*, http://www.w3.org/TR/1999/NOTE-xml-schema-req-19990215, W3C Note 15 February 1999

[W3C 1999b] The World-Wide Web Consortium (1999). *Document Definition Markup Language (DDML) Specification, Version 1.0*, W3C Note, 19-Jan-1999 http://www.w3.org/TR/NOTE-ddml

[W3C 1998b] The World-Wide Web Consortium, (1998). *Document Object Model (DOM) Level 1 Specification Version 1.0*, http://www.w3.org/TR/1998/REC-DOM-Level-1-19981001, W3C Recommendation 1 October, 1998

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Database based Navigation Assistant

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Abstract: This paper describes the conception and prototype implementation of a navigation assistant to be used during browsing sessions in the World Wide Web. A local gateway configured as proxy for the browser logs each browser request in a database. Simultaneously a JAVA Applet shown in an additional window displays the browsed URLs hierarchical in an extended tree-view. The tree-view allows the user to explore the structure of the visited web sites. Therefore, the tool provides fast movement to previously visited URLs. A time series extends the tree-view and allows the user to determine the historical order of the recent requests.

1. Introduction

With the growing importance of the World Wide Web browsing becomes a common activity for most people. The browsing sessions are supported by many tools. The first tool to mention is the personal bookmark file provided by each browser. It enables the user to store links to visited documents in a clear fashion. They can be commented on and ordered by in a hierarchical structure. Another support in the same direction is given to the user by the web portals offered by most search engines. They can be customized in a personal manner and provide easy access to current information. Both, bookmark file and web portal offer great help in remembering document locations and in the later case often offer new links as well [GVU 1996]. But they do not support the current navigation matter during the browsing process. They just offer entry points where to start the browsing session. Although this is a very important aspect, the support of navigation should not be neglected. Navigation is in close contact with movement. Tools that support navigation must provide such entry points on the one hand and allow to control the movement in the space of the World Wide Web on the other hand. Such a control can be given in several different ways. A very simple but helpful feature [Catledge 1995] of this kind is the browser history. Browsers provide a history file that enables the user to navigate in his recent history. By the use of the back and forward button the user can move easily to previously visited documents. The history lists of the browsers show the URLs of the documents as they have been accessed in their historical order. History lists are just flat files equal to a stack that allow the access of recently visited documents. They lack a presentation of the structure of the visited web sites, since they are one dimensional. A two dimensional presentation [Dömel 1995], a kind of site map is sometimes provided by the web sites itself.

There are different methods to build helpful site maps. Many of them [Ayers 1995], [Hirsch 1997] use tree-view like presentations of the hierarchical order of the directories and documents. They provide good support for navigation inside of a web site. Since only a little number of sites provide such functionality, it is a more general approach to implement such a navigation assistant on the client side. Of course, in this case it is not possible to represent the structure of the complete web site. But instead, the combined structure of different web sites can be visualized at the same time.

2. Requirements for a Navigation Assistant

The implementation of a local navigation assistant must fulfill several requirements. On the one hand there are technical requirements. On the other hand there are features that are required to optimally support the user. Since one aspect of the great importance of web browsers is their ability to provide the same functionality to access documents on different platforms, it is very important to implement the navigation assistant the most platform-independent as possible. But not only the different platforms have to be taken into consideration. Each browser is slightly different in its implementation. An aim of the navigation assistant must be to run at least on the most important current browsers. Of course, the assistant has to stay in the background if the user does not need its support. It must be implemented as an additional value that can be used if required but that does not hinder the user while working. Furthermore, it should provide a long history functionality that facilitates the finding of documents accessed some longer time ago.

The main feature that the assistant must provide is the visualization of the navigation path. It must display the structure of the visited web sites, but also show the location of the actually accessed document in that structure.

The access to any URL displayed in the assistant should be easy and fast. Finally, it would be nice if the user could attach comments to URLs. A classification scheme would be an optional feature of the category 'nice-to-have'.

3. The Navigation Assistant

Out of these assumptions consequences for the implementation arise. Since the navigation assistant should be implemented mainly as a platform and browser independent tool, it seems impossible to use a browser feature such as the history function for the implementation. Although the use of the browser history in combination with a Java-script is principally possible [Bekavac 1998], this solution is hindered too much by security restrictions in its functionality. The access to the browser's history-log-file by some other tool is hindered by the lack of a common browser history log file format. In spite of web servers, that use a more or less common log file format, each browser uses its own conventions for logging. Since browser history files differ depending on the used browser type, the creation of an own history list is desirable. This solution is browser independent and provides a maximum of freedom for the implementation of additional functions that support the user in navigation. One possibility to access the user's browse history, is the use of a proxy server for browsing. Since a proxy can be configured as gateway, it can easily be used to log the browsers requests. Furthermore this solution allows the user to switch the logging function on or off just by configuration of his browsers preferences. A comfortable method for logging is the use of a database. The data stored in the database is almost instantly available for other applications. Especially the navigation assistant is such an application. Therefore, the assistant has to be a database aware application. Based on the browse history stored in the database, the assistant provides the capability to display the hierarchical dependencies of the browsed URLs. In order to present that structure to the user, a appropriate designed tree-view can be used [Mukherja 1995]. The tree-view has the advantage

[Czerwinsky 1997] that many people are used to working with similar programs as the windows file-manager. They also display documents in tree-views and allow the users to explore with them the structure of the file system. In spite of a tree-view of the file system that is based on the complete set of directories and files available on the computer, the navigation assistant can of course only present those directories and documents that the user already requested during the browsing sessions. For those elements already visited, the navigation assistant enables the user to explore the underlying directory structure. Next to the aspect of exploration, this facilitates and quickens the navigation to previously accessed documents that are located in different branches. URLs can be accessed quite fast without a confusing search in the history list. It becomes easy to determine neuralgic locations in the web sites that should be preferred for further exploration.

Nevertheless, a tree-view alone can hardly display the navigation path the user took. Therefore, an additional feature is required. A time series is that feature. The combination of both tree-view and time series does not only display the documents the user visited but also shows the sequence of requests. This enables the user to determine in which order he visited a URL and how it fits in the web site structures.

In spite of the time-series that supports the user most effectively in the recent history, a URL classification and documentation functionality provides a more long term support. URLs can be classified by many different classification schemes. For example classification schemes can be the document type or importance of a document located at the URL, the affiliation to a subject and the availability (short or long term). Combined with prediction facilities as they are mentioned in [Tauscher 1997] the tool will support the user very well in browsing.

3.1 Prototype Implementation

Since the browser independence requires a gateway to create the browse history, the prototype implementation of the navigation assistant consists of three components. Those components are the gateway, the database and the client, which is the front-end for the user. A brief overview of the system architecture is shown in [Fig. 1].

Because of the aim of platform independence the prototype assistant is implemented in JAVA. While the gateway is implemented as a JAVA application, in the context of browsing a JAVA applet is a good choice for the client. While browsing with one or more windows the user can open an additional window that contains the applet. Now the user can easily switch between the assistant applet window and the browser windows. Since gateway and client can connect to the database at the same time without any conflict, the client has immediate access to the requests logged by the gateway. So the users is always given the most recent URLs he/she has visited.

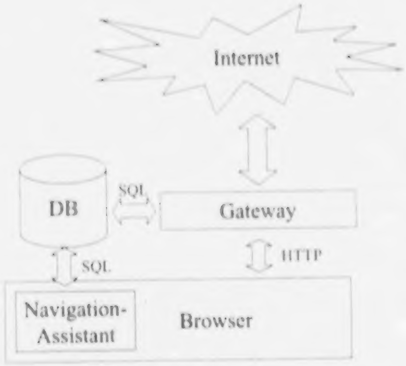

Figure 1: *The system architecture with the gateway that logs each browser request into the database (DB) and the Navigation Assistant that uses the database for the provision of the navigation structure.*

3.1.1 The Gateway

The gateway is a JAVA application that runs as a multithreaded server [Sridharan 1997] program. On the startup the server reads a configuration file that specifies the system parameters. Such parameters are e.g. the hostname, the gateway port, a probable proxy and the database connection parameters. The server process listens on the configured port. It requires HTTP 1.0 as protocol for the browser requests. Although the server is accessed as an HTTP proxy by the browser, at the moment it provides no proxy functionality at all. It is configured as a gateway that transfers the requests of the browser to the web servers specified in the requests. An additional proxy to be used by the gateway can be configured. For privacy reasons the gateway by default accepts only requests that are sent by a browser on the same computer. Also, as this mechanism does not work in a multi user environment, it provides sufficient security on a single user system at its recent prototype state.

When the gateway is initialized, each request transferred by it is logged to the database. Furthermore, the responses of the web-servers concerning the mime types of the delivered documents is also stored in the database.

3.1.2 The Database

The navigation assistant uses a conventional relational database as history file. This database is accessed via JDBC [Reese 1997] by the gateway and the client. Therefore it is easily possible to switch between different databases that are available on the desired platforms.

The data model, needed to fulfill the requirements of the navigation assistant, is quite simple. It consists of three entities. The main entity is the URL. Attributes of the URL are the connection address, the mime type and the comment. The mime type is handled as an entity itself. The last entity is the Visit. The Visit just has a timestamp as attribute. The relation between URL and Visit can be describes like each URL was visited at least once. Of course a URL can be visited numerous times. Further entities will be added to the data model with the implementation of further classification schemes and the provision of further functionality.

3.1.3 The Client

Since the navigation assistant is to be used during browsing the implementation as a JAVA applet was the obvious choice. While browsing the user easily can open an additional window to start the navigation assistant. After the initialization the applet opens a frame that contains the tree-view component. A menu in the top allows the configuration of display parameters. Three different views are available. The frame will either display the tree-view alone or with the time-series or comments on the right hand of the tree-view. For each view the time-window to be displayed can be chosen. By default, the client displays the URLs requested at the current day. The bigger the time window becomes the more the number of URLs to be displayed increases. Since the program is coded in JAVA, the performance is poor if the list becomes to big.

When the client queries the database a list of URLs matching the criteria is created. The URLs are parsed and the server addresses are extracted. This list of visited web servers is used to generate the nodes on the first level

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of the tree-view. In a recursive way, visited documents, directories and subdirectories are attached as leafs or folders to each node as it is shown in [Fig. 2].

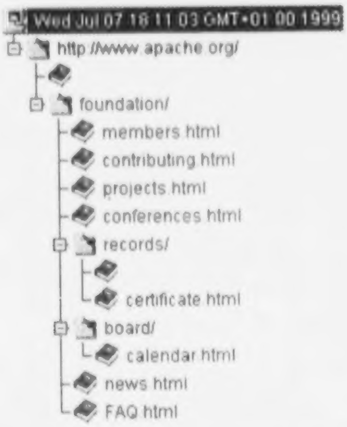
Wed Jul 07 18:11:03 GMT+01:00 1999
http://www.apache.org/
foundation/
members.html
contributing.html
projects.html
conferences.html
records/
certificate.html
board/
calendar.html
news.html
FAQ.html

Figure 2: *A sample part of the tree showing the web-server with its browsed documents and subdirectories. One can easily determine the directory structure of the visited web-site. Naturally only documents with their location in the directories requested by the browser in the time period can be displayed*

A click with the left mouse button will open or close the folder in the tree-view. If a folder or document is clicked on with the right mouse button the browser will open the document located behind this folder or leaf in a new window. Thus it becomes easy to access any previously visited document. Since the assistant is to be used only periodically at certain occasions, the update of the tree-view and its additional views has to be done manually.

With the time series representation [Fig. 3] a third dimension is added to the two dimensional view that is given by the tree-view component itself. It consists of a time axis that is displayed on the right hand of the tree-view. The axis of ordinates is given by the entries of the tree-view itself. Since the tree-view requires a lot of space to display the nodes in a readable size, the space available for the time-series representation is limited. The used tree-view component provides the capability to display any user data in columns next to each folder or leaf icon. For the ease of the prototype implementation this capability is used to display the time series on the right hand of the tree-view. For each entry in the tree-view an adequate set of user data is generated that results in a flag at the right position on the time axis. A URL that was called n times in the recent history is represented with n flags in the time-series.

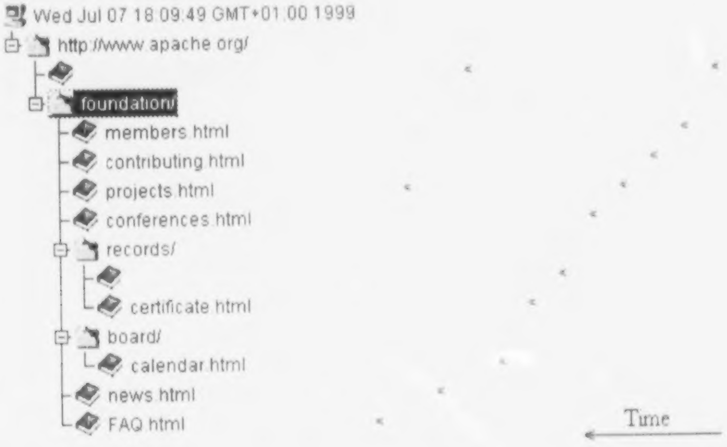
Wed Jul 07 18:09:49 GMT+01:00 1999
http://www.apache.org/
foundation/
members.html
contributing.html
projects.html
conferences.html
records/
certificate.html
board/
calendar.html
news.html
FAQ.html
Time

Figure 3: *The time-series representation showing the way the user took while browsing on the web-site. The session started at www.apache.org, the next document requested was /foundation/members.html. The flags on the right hand display the temporal sequence.*

As it is known from the bookmark function of browsers, it is nice to attach a small comment on certain URLs. The navigation assistant provides a similar functionality. If the users selects this representation form, the tree-view's user data as it is mentioned above will be set to the comment for a URL instead of the time-series. Comments may be entered or removed by the use of the menu.

3.1.4 Limitations of the prototype

The navigation assistant cannot keep track of any movement the user undertakes in the browsers cache. Since this will not produce a request that is sent via the proxy, it will not be logged to the database. Therefore the navigation assistant will only work in the expected way, if the browser cache is disabled. A solution for this problem is a complete proxy functionality of the proxy program as it is discussed in the outlook. Another limitation arises from dynamic documents. URLs that consist of content generated dynamically by a server side script depend usually from the parameters sent with the request. The same URL can represent different contents changing from visit to visit. The tree-view will not distinguish between such documents if the parameters are transferred with the HTTP POST method.

4. Outlook

Since the system at the moment only works in the expected manner if the browser cache is disabled, the implementation of a complete proxy functionality is aspired. The documents can be stored in the database next to the URL. Based on the documents stored in the database a local search engine for historic documents can be implemented. Furthermore, the sphere of documents and directories known to the system can be enhanced by the extraction of links from the browsed documents. Those links can be displayed as child leafs of the document leaf in the tree-view. It would allow the user to follow in an easy way the links originating from any document. In combination with an intelligent prefetching mechanism, a satisfying overview of the visited web sites would be available.

5. Conclusion

By combination of two dimensions in space and one dimension in time the described system allows a navigation in the browse history that is a lot more accurate than the default history function given by the browsers. Particularly, the described system provides two main advantages for the user: On the one hand, it supports the user in exploring the web-site(s) he/she visits with a file manager like tree-view. The tool gives him/her a good overview about the internal structure of the web sites, which eases the finding of previously visited contents. Furthermore, it becomes very easy to reload already visited pages.

On the other hand, the time series representation allows the user to track the navigation path he/she went on in the near history. This makes it easy for him/her to determine certain critical navigation points in order to follow other links from there or to add them to the bookmark file.

A prototype implementation allowed to test the usability of the navigation assistant concept. Although the prototype only demonstrates the aspired functionality it can offer very helpful support for browsing in the world wide Web.

6. References

[Ayers 1995] Ayers, E.Z., & Stasko, J.T. (1995). Using Graphic History in Browsing the World-Wide Web. *Fourth International WWW Conference*
http://www.w3j.com/1/ayers.270/paper/270.html

[Bekavac 1998] Becavac, B., & Rittberger, M. (1998). Ein Navigationsassistent für das World Wide Web. 6th. International Symposium on Information Science (6), Prague, Czech Republic, *Knowledge Management und Kommunikationssysteme*, 438-452

[Catledge 1995] Catledge, L.D., & Pitkow, J.E. (1995). Characterizing browsing strategies in the World-Wide Web. *Computer Networks and ISDN Systems*, 6 (27), 1065-1073
http://www.igd.fhg.de/www/www95/papers/80/userpatterns/UserPatterns.Paper4.formatted.html

[Czerwinsky 1997] Czerwinsky, M., & Larson,K. (1997). An Initial Examination of Tree Navigation versus Hyperbolic Browsing during Search: The Microsoft Site Analyst. British HCI
http://www.research.microsoft.com/research/ui/marycs/bhci97.html

[Dömel 1995] Dömel, P. (1995). WebMap: a graphical hypertext navigation tool. *Second International World-Wide Web Conference: Mosaic and the Web*. Chicago, IL, USA, 17-20 Oct 1994, *Computer Networks and ISDN Systems* (28) 1-2, 85-87

[GVU 1996] GVU.*(1996) GVU's WWW User Survey. Browsing Strategies.*
http://www.cc.gatech.edu/gvu/user_surveys/survey-10-1996/graphs/use/Browsing_Strategies.html

[Hirsch 1997] Hirsch, F.J., & Meeks, W.S., & Brooks, C.L. (1997). Creating Custom Graphical Web Views Based on User Browsing History. *Sixth International WWW Conference*
http://www.camb.opengroup.org/RI/www/waiba/papers/www6/hg.html

[Mukherja 1995] Mukherjea, S., & Foley, J.D. (1995). Visualizing the World-Wide Web with the Navigational View Builder. *Computer Networks and ISDN Systems*, 6 (27), 1075-1084

[Reese 1997] Reese, G. (1997). *Database Programming with JDBC and Java*, O'Reilly

[Sridharan 1997] Sridharan, P. (1997). *Advanced Java Networking*. Prentice Hall

[Tauscher 1997] Tauscher, L., & Greenberg, S. (1997). How People revisit web pages: empirical findings and implications for the design of history systems. International Journal of Human Computer Studies, 1 (47), 97-137
http://www.hbuk.co.uk/ap/ijhcs/webusablity/tauscher/tauscher.html

Object Learning on the World Wide Web

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Abstract: Combining resource-intensive learning objects with rapid, template-driven course design provides a cost-effective method for developing pedagogically sound online courses. This paper describes the implementation of such a system at San Diego State University, with a detailed example of a learning object and an in-depth description of course design. Learning objects are self-contained, multi-purpose instructional modules separate from a course. Learning object are integrated into a course by adding a "docking object" which may connect the object to other course content, or give special instructions. Learning objects can be time-consuming and expensive to develop, so we integrate them into a pedagogically sound instructional environment that is easy and inexpensive to develop (I CARE). I CARE is an acronym for Introduction, Connect, Apply, Reflect, and Extend. By carefully combining these two types of systems, organizations can maximize the effectiveness of online training and education through object learning on the World Wide Web.

What is a learning object?

Broadly speaking, a learning object is a piece of instruction or a learning environment that may be used in a variety of ways, for a variety of purposes. Beyond that, definitions vary widely, from "any specific type of content that has been bundled together as a single unit" [Connolly, 1998] to David Merrill's description as every piece of text, every picture, every video scene, and every component of an instructional product. For Ms. Connolly, objects contain objectives, content and assessment, providing the optimal structure for affording reuse of knowledge.

Here at San Diego State University's Department of Educational Technology we adopted a learning object approach for a five-course online certificate program in Multimedia Development. The SDSU Defense Conversion program sponsored the development of the course objects and the course management and tracking system.

For our purposes we like to think of a learning object as a more-or-less self-contained, multi-purpose, scalable, and re-usable instructional module. Our objects are intended for use in the context of instructor-facilitated university graduate courses. The objects are mainly web-based and are integrated into a pedagogically sound online course delivery system known as I CARE.

We set the following benchmarks as we set out to design our objects.

- Objects should be self-contained, and independent of other learning material— that is, a learner should be able to complete an object successfully without access to additional materials.
- Objects should feature well-defined prerequisites. For instance, before being able to use the *Visualization* object described below, learners must already know how to categorize types of learning objectives.
- Objects should require only "docking objects" to integrate them into a course. Docking objects might specify objectives, assign a particular task or approach to using the object, and evaluate or otherwise integrate the learner's experience with the object back into the context of the course.

In this paper we will explore one example of a learning object in depth, and then examine the course structure in which that object is integrated.

EPSS for Visualizing Information

An example of a learning object in this context is *Visualization*. We developed the *Visualization* object for the Multimedia Development & Management Program Distance Learning Project at the SDSU Defense Conversion Center.

Visualization is an Electronic Performance Support System (EPSS) for helping designers specify appropriate visuals for instructional products such as presentations, computer-based training, job aids, informational web pages and kiosks, and so forth.

According to the dual-coding theory of working memory [Paivio, 1991], most ideas are easier to understand with a picture than with words alone. Words and pictures are stored in the brain separately, but are linked with one another. If your brain can't immediately retrieve the words, it might be able to retrieve the image that illustrated the words, and thereby eventually retrieve the words as well. Brain hemisphere research shows that verbal and visual learning are different, but when combined they strengthen one another [Sousa, 1995, p. 96].

Visualizing information is an important theme in training new instructional designers and educational multimedia developers. Recent developments in imaging and image processing have made visuals less expensive to produce and distribute than ever before. Yet much of what educational technologists have done in the past is write instructional or informational text. Visuals are often an afterthought or developed unsystematically as the need becomes obvious or as ideas occur to graphic artists or video producers, usually untrained in visualizing information.

The *Visualization* object takes the form of an electronic performance support system, or EPSS. An EPSS is a combination of an expert system and a tutorial. As an expert system, it prompts users to enter information and make decisions, and delivers a recommendation—in this case, a specification for an instructional or informational visual. As a tutorial, it helps learners understand the rationale that lies behind choosing one approach or system over another. The *Visualization* EPSS is designed to be used by novice instructional designers until they internalize the principles and examples they need to specify visuals without the aid of the EPSS.

Let's walk through a typical visualization problem with the help of the *Visualization* object. The EPSS involves a six-step process, with the seventh step displaying the recommendation or specification.

At the beginning of the object, there are three optional pages of introductory information (http://defcon.sdsu.edu/1/objects/visual/intro/). For newcomers, these pages explain the purpose of the object and how to use it, and introduce some basic concepts such as a taxonomy of both concrete and abstract visuals, including still and motion pictures (photos and drawings); conceptual, temporal, and spatial diagrams; and pie, line, and bar graphs.

1.1 Step 1: Objective/Topic

Repeat users may skip the introductory screens and go directly to the first decision screen (http://defcon.sdsu.edu/1/objects/visual/index.htm) which prompts them to identify the type of information—the type of objective or topic—they wish to visualize. We used the popular Facts, Concepts, Principles, Processes, and Procedures taxonomy described by Clark [1989] and others.

While classifying information types is not the central theme of this EPSS, learners can access definitions and examples by rolling their mouse over the name of each type. When they've identified the type of information they wish to visualize, they select it by clicking on a button, and type in a brief description of the topic or objective in a text box.

Suppose we classify the topic we're visualizing as a "concept," type in a few words about the concept, and then click on "Next" to go to the next decision point.

1.2 Step 2: Questions

This screen suggests a number of questions about concepts (or whatever you classified your topic as in Step 1) that visuals can help answer. For instance, when people are trying to understand a new concept they might want to see an example of a concrete concept or an analogy of an abstract concept. They might benefit from seeing the parts or characteristics of the concept or understanding its subordinate or superordinate categories.

Again, rollovers present users with descriptions and examples of the questions. There is no need for the user to type in specific questions—it's enough to identify the type of question you wish to address with the visual. In this case, we'll select "Parts" and click on "Next."

1.3 Step 3: Representation type

The next screen offers a list of appropriate representation types, based on the type of information and the question specified in the two previous screens. Notice that these decisions, as well as the description of the objective we typed in Step 1 are displayed for the user's reference at the top of each screen. These accumulate at each step until the complete specification is shown.

In this case, we want some suggestions as to how to represent the parts of a concept. The EPSS suggests using a still or motion drawing, a spatial diagram, a still or motion photo, or a concept diagram, in order of likely usefulness. We can weigh the choices ourselves by reading brief text descriptions available as rollovers and viewing example visuals by clicking on their titles.

We'll choose "Still and motion photographs" and click on "Next."

1.4 Step 4: Production methods

Once we know what type of representation to use, we can determine an appropriate production method. For instance, for a photograph, we might consider archival sources such as clip art or libraries, or we might have the resources to send out our own photographer to capture the image. Rollovers help users assess the pros and cons of each method.

There's no need to click on a choice here, but if the user wishes they can type some notes to flag a particular clip art file or give specific directions to a photographer or illustrator. In the case of a diagram or graph, the user can suggest the sources, methods or software tools for producing what she wants.

We'll type in some specifications and click on "Next."

1.5 Step 5: Visuals and text

As we noted earlier, visuals used appropriately in conjunction with text are usually more effective than either media used alone. This screen prompts the user to consider that fact and specify appropriate labels, captions, or other accompanying text. As before, rollovers remind users of the utility of each option and a few rules of thumb for writing each one.

We'll specify some labels for the parts in our photograph and click on "Next."

1.6 Step 6: Visuals and sound

Similarly, speech, music, and sound effects can complement visuals (and text) to help people understand. This screen prompts the user to specify audio to accompany the visual, if appropriate.

We'll pass on this option and click on "Next."

1.7 Step 7: Summary

This page displays the finished specification for the visual. There are many, many variations in the specification, based on the type of objective or topic we identified, the question we wish to address, the type of representation we choose, the production method, and any text and sound we specify—the choices available in the steps outlined above. Given other knowledge types or questions, users might be prompted to specify a timeline, a map, a table, an exploded diagram, or a pie graph.

If the user is working through the EPSS in order to specify a visual for a school or workplace project, they may wish to copy the specification to a text file or print it, available from the page following the Summary. Alternatively, they can return to Step 1 and begin specifying another visual.

This EPSS is but one example of a variety of objects we're creating for the Multimedia Development distance learning project. It exemplifies the object approach as we understand and are using it.

The *Visualization* object is re-usable—it can be used repeatedly by learners at a variety of levels, and by instructors in a variety of educational settings. It is designed to serve a variety of purposes, from introducing basic ideas about types of visual representations and production methods to internalizing more sophisticated heuristics for specifying appropriate visuals. It can be used in the context of instruction or in on-the-job environments. It is scalable, to accommodate short course-related assignments, whole instructional units, or extended production work. It is self-contained in that it provides enough internal explanation and direction to enable almost any learner to succeed in accomplishing their objective.

Like other objects, instructors can integrate the *Visualization* object into their courses by developing a simple "docking" objects. For example, in our Advanced Multimedia Development course here at SDSU Educational Technology, students receive specific assignments for which they must use the *Visualization* EPSS. They launch out to the EPSS from the assignment web page, and when they return they receive feedback on their own specifications for a visual in the form of one or more model specifications provided by the instructor. Later in the course they use it to prepare specifications for their own course projects.

The I CARE system

For objects to be used effectively, they must be integrated into a larger system. Because the objects we built required careful design and, in many cases, more extensive (and expensive) development to achieve the production values we desired, we decided to integrate them into a course system that provides a pedagogically sound instructional environment but is easy and inexpensive to develop. We settled on the I CARE system, which we developed several years ago with a grant from the California State University Office of the Chancellor to train university professors to develop online courses.

I CARE is an acronym for Introduction, Connect, Apply, Reflect, and Extend. Using the I CARE system helps content experts, instructors, and other course developers remember and apply principles of good teaching to their online course modules.

At the same time, it provides a framework that helps learners focus their learning efforts effectively. Indeed, we found it helpful to make the system apparent to the students. We discovered that when learners are aware of a clear lesson structure they will spend more time focusing on the content and less time guessing about what is expected of them.

The elements of I CARE are based on widely accepted lesson planning and instructional design systems common to the fields of educational psychology, teacher education, and curriculum development. These lesson planning or instructional sequencing systems are based, in turn, on brain and cognitive scientific research.

The I CARE system may be adapted to fit any content area. Indeed, in our original CSU faculty development project, professors in content areas from physics to foreign languages, and from engineering to the humanities, successfully used I CARE to create online course modules.

Instructors who teach face-to-face go into their classrooms early to arrange chairs, adjust the temperature and lights, lay out materials, and so forth. They prepare the environment for learning to take place. The I CARE system affords online instructors a similar way to prepare the virtual learning environment for their students.

A typical I CARE course might look like our own Advanced Multimedia Development course (http://coe.sdsu.edu/courses/et561/ and click on modules 1, 2, or 3). Each of the elements of I CARE serves a distinct purpose.

1.8 Introduction

The introduction of an online module should include two key elements, the context and the objectives:

Context. The introduction initiates the module by explaining how this particular section fits within the context of the online course as a whole. It reminds learners about what they have already learned, how this new information will build on previous knowledge, and how it is relevant to them.

Objectives. An example of an objective is:

"At the end of this lesson you will be able to identify and describe the function of the major organs of the respiratory system."

Including clearly stated objectives is important to good instruction. First, objectives provide instructors or course developers with a sound basis for the selection or design of instructional content and activities.

Second, objectives are useful for evaluating or assessing the success of instruction. Third, objectives can be an advanced organizer which sets learner expectations. This allows learners to form a meaningful scaffolding to which to attach the content which is about to be presented [Mager, 1984].

1.9 Connect

This area is where learners acquire new information and concepts. Important guidelines for structuring the Connect section include:

Chunk Information. Short-term memory holds about seven chunks or bits of information at a time. If material is organized into chunks there is a better chance that learners will encode this information into their long-term memory. Moreover, small chunks of text are easier to read on screen.

Provide Context. Learning can be made more meaningful to students by setting the new information within the context of real-world tasks. For example, if a course objectives is for students to learn how to collect and identify flowering plants, it might be useful to point out how this knowledge or skill will be useful to them in their future career as a botanist.

Consider Prior Knowledge. Take into account learners' prior knowledge of the topic. Provide ways for them to preview the content so that they can focus on what is relevant to their needs. Features for activating prior knowledge include tables of contents, headings, marginal notes, questions, visuals, and other cues.

Accommodate Learners. Provide students with multiple forms of representation to help them visualize concepts. There are several ways to do this: illustrations, visual analogies, demonstrations, graphs, diagrams, and tables, to name but a few. For instance, course developers might use a diagram to illustrate how bacteria reproduce, or a visual analogy to relate an abstract idea to a concrete one.

The connect section often serves as a docking object to a learning object. By providing some background information and context, it prepares learners to engage in particular ways with the object. For instance, a Connect section that docks with the *Visualization* object described above might prompt learners to pay particular attention to the classification of types of information, or it might prepare them to question the taxonomy of types of representation.

1.10 Apply

This is where learners practice using the new information in an "authentic" context. The practice should relate closely to the stated objectives for the module. Practice activities may be online or off. Online activities might include learning objects or parts of them. Offline activities might involve field visits, interviews, hands-on projects, and so forth.

An Apply section might dock with the *Visualization* object, for example, by posing a particular visualization problem for learners to solve using the EPSS. When they return from using the EPSS, the Apply section could provide feedback in the form of model specifications.

1.11 Reflect

The purpose of this section is to encourage learners to articulate their newly acquired knowledge both to themselves and to others. This provides learners opportunity to mentally process and organize their thoughts and construct or amplify their mental schema or conceptual structure. For example, learners might construct a concept map of the new content. A concept map is a visual representation of the relationship among concepts and can be an effective learning tool for many students:

Another way to promote reflection is to have learners communicate their thoughts and ideas to the instructor or, perhaps better, to their peers. Much has been written about building online communities using strategies such as online chat, email exchanges with peers or instructors, posting to a threaded forum, or participating in a listserv.

1.12 Extend

Extending the module includes enrichment, remediation, and/or evaluation activities.

Enrichment and remediation. Course developers can provide enrichment activities or resources for "further information" for learners who have mastered the content and are excited about learning more. For those learners who are less successful, include remediation exercises. This is also a good area to provide "if time permits" activities for learners who may want additional practice with the same content.

Evaluation. There are two things to evaluate—the learners accomplishments and the course module or program itself.

Instructors may want to know whether or not students have learned what was intended. Be sure to base this evaluation on the original instructional objectives stated in the Introduction section of the module. Students may evaluate their own learning or you can build in electronic or other assessment systems to measure skills and knowledge. This will help determine grades and provide students with useful feedback. Evaluation may be quantitative or qualitative.

Evaluation is also an opportunity to determine the success of the course of module design. Course developers may want to know whether learners have difficulty navigating through the pages, or whether some section requires elaboration, or how they might modify learning activities so that students are more apt to complete assignments and learn more deeply and easily. The answers to these and other questions can help them make necessary revisions to courses, modules, and objects for the next iteration of the course.

In addition, course designers may be held accountable to sponsors and need to provide information about how well students are receiving the online instruction.

Conclusion

The I CARE system provides a pedagogically sound, easy and inexpensive framework for delivering online instruction. It provides a variety of opportunities to dock with selected learning objects, carefully designed and (usually) developed at greater expense.

By carefully apportioning resources between these two types of systems, organizations can maximize the effectiveness of online training and education through object learning on the world wide web.

References

[Clark, 1989] Clark, R. (1989). *Developing technical training*. Phoenix: Buzzards Bay Press.

[Connolly, 1998] Connolly, C. (1998). Empower Corporation. Available: http://www.empower-co.com/

[Mager, 1984] Mager, R. (1984). Preparing instructional objectives. Belmont, CA: Lake Publishing Company.

[Paivio, 1991] Paivio, A. (1990). Mental representations: A dual coding approach. New York: Oxford University Press.

[Sousa, 1995] Sousa, D. (1995). *How the brain learns*. Reston, VA: The National Association of Secondary School Principals.

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Tools of Innovation: Supporting Change Through Online Web Solutions

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Abstract: Educational institutions have long been involved in planning and implementing new initiatives, but with the profusion of technology innovations, the race to stay ahead of the game has intensified. Planet Innovation is a grant-funded organization offering online solutions for technology planning and implementation, especially in K-12 schools. This paper will discuss two online tools that support an essential element of technology planning - the staff responsible for integrating technology in their curricula. A web-based instrument for measuring concerns about adopting innovations and the development of a user-centered web site designed for communicating technology stories and networking among teachers will be described.

Introduction

Educational institutions have long been involved in planning and implementing new initiatives, but with the profusion of technology innovations, the race to stay ahead of the game has intensified. In today's climate of rapid change, Wall says it is "difficult for anyone outside the industry to stay current" [Wall 1994]. Technology planners face a number of issues in making decisions about technology acquisition, implementation, and evaluation. Among them are nuts and bolts decisions concerning types of networking and equipment, software, and access [Fries & Monahan 1998; Rennie 1996]. Ongoing cost considerations for upgrades and maintenance are essential, yet often overlooked [Davis 1995].
However, providing technology equipment is only the beginning. Sustaining the human infrastructure that shapes the equipment into tools of learning is vital. Too frequently, we find schools equipped with adequate hardware and software that is virtually unused. Equally disheartening is finding the school where technology is being misused. Instances abound:

- Computer labs where technology is seen as separate from everyday learning activities and classes are scheduled for routine lab time.
- Teachers who use computers as little more than a time-filler for students who have completed their work or who offer computer game time as a reward for desired behavior.
- Instructional methods that waste technology's potential by offering the equivalent of electronic worksheets.

This paper will discuss online solutions that support an essential element of technology planning - the staff responsible for integrating technology in their curricula [Strudler 1993; Weiss 1996]. For optimum use of technology to occur, many components must be in place. Shared vision, adequate training and support, sufficient infrastructure - all are vital for full utilization of technology's capacity [Wedman, Laffey, Andrews, Musser, Diggs, & Diel, 1998]. And, "at the center of it all, 'headware,' not hardware, is the central element in the successful development of an effective, coherent, and cohesive long-range plan for technology in K-12 schools" [Jukes 1996]. Ultimately, student success is the goal of both administrators and teachers. Yet success does not happen accidentally.
We will describe the development and application of web-based tools that support reflective decision-making, change and ultimately, success. Two solutions using two different strategies to

address the critical area of support for technology implementers will be examined. The online Stages of Concern About the Innovation Questionnaire (SoCQ) tool assesses staff concerns about innovation use as a first step in identifying and developing appropriate assistance. TechConnect, a web site for sharing stories about technology use in educational environments, illustrates a mechanism for supporting change and technology use through creating a networked community of users.

Planet Innovation

To understand the development of these two change tools, it is helpful to situate their origins. Since 1995, Planet Innovation has been part of the Center for Technology Innovations in Education (CTIE), which operates on the University of Missouri-Columbia's College of Education campus. The purpose of the Center is to engage in research and development dedicated to the innovation of new technologies for the support of teaching and learning. Planet Innovation grew from the U.S. Department of Education's establishment of the Regional Technology in Education Consortia (R*TEC) program, whose goal is improving student achievement through technology. The R*TEC emphasis is on improving teaching and learning, professional development, and infrastructure development. A unique feature of the R*TECs, in contrast with similar organizations, is their exclusive focus on effective technology use to support school reform [U.S. Department of Education 1998].

During early regional planning, the South Central R*TEC (SCR*TEC) identified online delivery as an emerging vehicle allowing asynchronous, wide distribution of information and learning resources. Initially, SCR*TEC's Planet Innovation specifically targeted administrators, technology coordinators, and other leaders involved in technology planning. The charge to use technology for driving school reform led to this decision. For real change to occur on a systemic level, in this case on the district or building level, it is critical that individuals in leadership roles make informed decisions. Change can and does occur in one classroom at a time, but is more likely to occur in a community that shares common goals and vision. To support decision-makers, Planet Innovation designed a web site offering tools that assist in technology planning, implementation, and evaluation.

Scheduling conflicts, time constraints, and distance barriers are limitations that may prevent groups of decision-makers from communicating effectively. To facilitate this process, Planet Innovation envisioned an on-demand web environment based on a model of "Right-Time, Right-Place, Right-Form" [Wedman et al. 1998]. This meant that technology planners could choose appropriate web solutions based on their individual needs and, if desired, form groups to work in a distributed environment. Participation in an online group is not contingent on physical location or precise time frames, with group members free to choose the most convenient time and place for collaborating with others. Among the online tools developed to assist the planning and decision-making process were a Group Calendar, Group Survey Creator, Delphi Planning System for group consensus building, and Stages of Concern About the Innovation Questionnaire (SoCQ).

Measuring Concerns About Adopting Innovations

One of the primary issues facing individuals responsible for facilitating innovations involves human nature more than the innovation itself. Individuals are often resistant to change, and many innovations fail because those in charge have neglected to adequately consider the people affected. Teachers are frequently expected to integrate new technologies and adapt their instruction, often with inadequate time, training, or information about the innovation's effect on their teaching or students.

Network connectivity has ushered in new possibilities for learning, with the potential of forever changing the way we think about the traditional school environment. While some individuals embrace these changes, others are less enthusiastic about adopting innovations. Hassinger, as described in [Rogers 1995], contends that people are open to an innovation only when they have a need that the innovation will fill. Even then, unless the innovation is relevant to that need, as well as consistent with the person's belief system, there will be little effect.

Change is a complex process involving not only the innovation, but also the growth of individuals *over time* as they implement the change [Hord, Rutherford, Huling-Austin, & Hall 1987]. Hord et al., describe common mistakes leading to innovation failure. Among them is the tendency to provide initial training without follow-up monitoring and additional help. A second mistake is viewing as identical all the individuals involved with the change instead of realizing that each individual will react uniquely to the innovation. The Concerns-Based Adoption Model (CBAM) was designed with the belief that the individuals affected by change are the most important factor in the change process [Hord et al. 1987]. The model provides tools that enable a change facilitator to offer support and interventions in a flexible, yet systematic, process.

A central part of the CBAM is the 35-item Stages of Concern About the Innovation Questionnaire that measures the current concerns of a person encountering change. Concerns are defined as "the feelings, attitudes, thoughts, or reactions an individual has related to a specified program or practice" [Rutherford, Hord, & Thurber 1984]. Statements are rated using a Likert scale with dimensions ranging from "irrelevant," or "not true of me now" to "very true of me now." The responses fall into one of seven stages. These stages consist of concerns about the innovation itself, concerns about effects it may have on the person responsible for implementing it, concerns about consequences it may have for students, and concerns about ways users can collaborate or extend the innovation.

The CBAM was developed through extensive research at the University of Texas in Austin to "conceptualize and facilitate educational change" [Hall, George, & Rutherford 1979]. Planet Innovation was granted permission to develop an online version of the Stages of Concern About the Innovation Questionnaire that could be administered either to a single user or to a group of educators. The tool was designed to calculate scores for each stage and display a graph representing each individual's position in each of the stages. Anyone who registers on the Planet Innovation web site has free access to creating groups and administering this survey instrument.

To begin a group survey, the innovation for which the statements are to be answered is entered into a text field. The group creator then builds the group by entering individuals' e-mail addresses in the Group Population Tool. This utility is used for all Planet Innovation tools that involve group collaboration or action. Next, an automatic e-mail is generated, prompting each group member to log-in to the Planet Innovation web site where they will find a notification linking them to the SoCQ. Upon completion of the survey questions, the data is automatically analyzed and available to the group creator. The results include individuals' scores in each of the seven stages of concern and a group graph representing each individual's results displayed in a different color. Thus, individual profiles may be examined as well as compared with others who are involved with the innovation.

The Stages of Concern Tool: Two Applications of Use

Pre-Service Administrators Using an Online Problem-Based Learning Environment

Because change facilitators are often educators in leadership positions, the following use of the SoCQ tool is of particular significance. To familiarize pre-service administrators with support tools for innovation adoption, the Information Environment for School Leader Preparation (IESLP) project is utilizing Planet Innovation's online SoCQ tool.

IESLP is a web-delivered, problem-based learning environment preparing students for leadership roles in education. Problem exercises and information environments are available to IESLP users, who access actual school data that has been entered with name changes to protect anonymity. Complicators for a situation may be introduced that keep the conditions fluid and changing, as would be expected in actual situations. Computers are used as information and communication tools for IESLP work groups, which are modeled after teams of education administrators as found in real-life settings.

Students have the opportunity to engage in practical problem solving, make proactive leadership decisions, and gain valuable insight into the responsibilities and competencies necessary for education administrators. The rationale behind IESLP is the endeavor to bring about fundamental change in school leader preparation. Rather than train leaders in a reactive or "in-basket" model, IESLP strives to change the underlying thinking of these individuals and to reform the way administrators approach their profession. Active "problem-finding" is emphasized, encouraging leaders to reflect and engage in identification of problems and opportunities [Mayer, Crawford, & Forsyth 1998]. IESLP learning modules may position students as administrators who seek to implement technology innovations or other changes in their schools. To underscore the importance of understanding the attitudes and readiness of staff members to adopt an innovation, IESLP turned to Planet Innovation's SoCQ tool.

As the tool was originally developed, only the group creator could view results for the entire group. Individual group members were allowed access only to their own results. Because IESLP students needed to understand how the tool works, adaptations were requested that would allow all members of a SoCQ group to view the entire group's results instead of giving that capacity only to the group's creator. Planet Innovation programmers modified the tool to allow a group creator the option for this level of permission when setting up a group SoCQ. Next, programmers set up a simulated group based on real-life data that IESLP provided.

IESLP's cohort groups are now able to use the SoCQ results to analyze staff needs and concerns about adopting innovations and to develop mediating support strategies. Knowledge of a tool that measures innovation adoption concerns and is easily accessed for online administration and scoring increases the likelihood that these pre-service administrators will remain aware of individual staff concerns as they implement changes as in-service administrators.

Teachers Implementing Online Curriculum

To illustrate a second application of the SoCQ tool, we next examine a small rural school district that acquired unlimited access to a commercial online curriculum program as a result of its membership in an educational consortium. Although the online curriculum had great potential and might have been highly successful in some schools, it was underutilized in this particular setting. Why? Several factors may have contributed to the situation.

First, the majority of the teachers had not identified the need for a resource such as the online curriculum. Second, the teachers were not integral to the planning process. Instead, the online program was presented with an initial training session and teachers were left to implement the program or not as they saw fit. Little follow-up or support was forthcoming. Clearly, a well-thought out process for initiating and sustaining this innovation was lacking. Third, it is possible that teacher beliefs about the efficacy or value of the program affected their level of adoption. If this innovation did not mesh with their attitudes about using packaged lesson plans, if they perceived the materials as lower quality than their current instructional materials, or if they found the mechanics of accessing the material online prohibitive, then non-adoption would be expected [Rogers 1995].

A group of seven teachers agreed to fill out the web-based Stages of Concern About the Innovation Questionnaire. Analysis of the results from this survey indicated that several individuals were not yet in the implementation stages, but had concerns regarding how to use the online curriculum and how it would personally affect them in regard to time and logistics. Until these concerns were recognized and appropriate support given, the teachers were unlikely to change their present teaching methods and adopt the online curriculum.

Issues of individual concerns are essential for change agents, who are often school administrators, to keep in mind as they plan for policy and implementation. In each of the stages of concern, there are identifiable strategies and assistance that a change facilitator can offer. Identifying concerns and offering support mechanisms increases the likelihood of the innovation's success [Hord et al. 1987]. Taking advantage of tools such as the online SoCQ gives change facilitators crucial information that is instrumental in successful adoption of innovations.

TechConnect

In studying professional development, a distinction is made between change driven by administrators and change agents and "bottom-up" movements that focus on the teachers involved in the change [Pennell & Firestone 1996]. Historically, teachers have been isolated in closed classrooms with little time or opportunity to collaborate or share their experiences. Recently, however, teacher networks have become powerful vehicles that encourage and value exchange among participants [Lieberman & McLaughlin 1992]. Face-to-face networks, while effective, encounter the constraints of time and physical proximity. This type of network is no longer the only model, as online social networks are developing that support collaboration and connection among teachers [Wellman, Salaff, Dimitrova, Garton, Gulia, & Haythornthwaite 1996; Reilly 1999]. Online networks can foster the "bottom-up" diffusion of ideas about using technology among teachers. The traditional barriers encouraging isolation are removed and change can occur in a grassroots method. A key concept in successful online communities is empowerment [Palloff & Pratt 1999].

Planet Innovation's goal in creating its companion web site, TechConnect, is to provide a networked community for sharing technology stories whose design is driven by the educators it serves. To achieve this, we initially surveyed 83 teachers to determine their preferences in content, delivery, and submission mechanisms. Although as developers, our initial plan was heavy reliance on audio as the delivery medium, 85% of those surveyed preferred a mixture that included text. Likewise, the preliminary plan for an automated recording system for teachers to submit technology stories was postponed because only 10% of those surveyed indicated the preference to submit information using this technique. Over one-half of the teachers preferred entering their stories in an online form. Of the teachers who responded to the question regarding their type of Internet access, one-third had 56K modems and one-third had Ethernet access. Since less than 20% of the respondents accessed the Internet using a 28.8K modem or less, streaming audio and video are options provided on many stories to enhance the user's experience.

At this time, teachers are beginning to offer their stories and we remain attuned to their needs in further developing the web site. Usability testing has occurred on a small scale and will continue. Future plans include additional online workshops with subjects determined by the users, a chat function to supplement the bulletin boards, and featured guests. Research goals focus on assessing the effectiveness of this approach in increasing technology integration in learning situations.

Conclusion

A key to successful change and innovation adoption lies within the individuals affected by that change. Support for those involved is a vital component of successful change and may include strategies that are initiated at the change facilitator level or that are generated by the individuals themselves. The online Stages of Concern About the Innovation Questionnaire is a proven tool that makes appropriate support strategies possible by identifying the current concerns of an individual regarding change in which he/she is involved. A second model of support is exemplified by TechConnect, which uses an online environment to create support through communication and collaboration. Web-based tools such as these offer increased possibilities for change by overcoming barriers and fostering connections.

References

[Davis 1995] Davis, M. D. (1995). A policy "pothole" in instructional computer planning. *Journal of Curriculum & Supervision*, 10 (3), 278-282.

[Fries & Monahan 1998] Fries, B. & Monahan, B. (1998). School district technology planning in an era of rapid change. *Educational Technology*, 38 (1), 60-62.

[Hall, George, & Rutherford 1979] Hall, G., George, A., & Rutherford, W. (1979). *Measuring stages of concern about the innovation: a manual for use of the soc questionnaire.* (R & D Report No. 3032). Austin: University of Texas, The Research and Development Center for Teacher Education.

[Hord, Rutherford, Huling-Austin, & Hall 1987]; [Hord et al. 1987] Hord, S., Rutherford, W., Huling-Austin L., & Hall, G. (1987). *Taking charge of change.* Austin: Southwest Educational Development Laboratory.

[Jukes 1996] Jukes, I. (1996). The essential steps of technology planning. *School Administrator*, 53 (4), 8-14.

[Lieberman & McLaughlin 1992] Lieberman, A. & McLaughlin, M. (1992). Networks for educational change: powerful and Problematic. *Phi Delta Kappan*, 73, 673-677.

[Mayer, Crawford, & Forsyth 1998] Mayer, C., Crawford, J., & Forsyth, P. (1998). *The information environment for school leadership preparation instructor guide.* Columbia: University of Missouri, University Council for Educational Administration.

[Palloff & Pratt 1999] Palloff, R. & Pratt, K. (1999). *Building learning communities in cyberspace.* San Francisco, CA: Jossey-Bass Inc.

[Pennell & Firestone 1996] Pennell, J. & Firestone, W. (1996). Changing classroom practices through teacher networks: matching program features with teacher characteristics and circumstances. *Teachers College Record*, 98 (1), 46-76.

[Reilly 1999] Reilly, R. (1999). EdNet@UMass: providing quality professional development via the internet. *T.H.E. Journal*, 26 (8), 60.

[Rennie 1996] Rennie, R. J. (1996). Information technology's role in educational organizations. *School Business Affairs*, 62 (2), 44, 46-47.

[Rogers 1995] Rogers, E. M. (1995). *Diffusion of innovations.* (Fourth ed.). New York: The Free Press.

[Rutherford, Hord, & Thurber 1984] Rutherford, W., Hord, S. & Thurber, J. (1984). Preparing principals for leadership roles in school improvement. *Education and Urban Society*, 17 (1), 29-48.

[Strudler 1993] Strudler, N. (1993). Staff development and technology: a position paper. *Journal of Computing in Teacher Education*, 9 (4), 8-10.

[U.S. Department of Education 1998] U.S. Department of Education. (1998). Network of regional technology in education consortia. *http://rtec.org/* (22 Feb. 1999).

[Wall 1994] Wall, T. J. (1994). A technology planning primer. *American School Board Journal*, 181 (3), 45-49.

[Wedman, Laffey, Andrews, Musser, Diggs, & Diel, 1998] Wedman, J., Laffey, J., Andrews, R., Musser, D., Diggs, L., & Diel, L. (1998). Building technology infrastructure and enterprises in a college of education: Increasing Performance Capacity. *Educational Technology*, 38 (5), 12-19.

[Weiss 1996] Weiss, A. M. (1996). System 2000: if you build it, can you manage it? *Phi Delta Kappan*, 77 (6), 408-415.

[Wellman, Salaff, Dimitrova, Garton, Gulia, & Haythornthwaite 1996; Reilly 1999] Wellman, B., Salaff, J., Dimitrova, D., Garton, L., Gulia, M., & Haythornthwaite, C. (1996). Computer networks as social networks: collaborative work, telework, and virtual community. *Annual Review of Sociology, 1996*, 22, 213-239.

Web-Based Distance Learning for Professionals in Higher Education: Orientation to Serving College Students who are Deaf or Hard of Hearing

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Abstract

The Postsecondary Education Programs Network (PEPNet) offers interactive multimedia web-based training on the PEPNet web site at www.pepnet.org. The training, entitled *Orientation to Serving College Students Who are Deaf or Hard of Hearing*, is designed for postsecondary education professionals who are serving students who are deaf or hard of hearing. The instructional goal of the project is to provide postsecondary administrators, faculty, and staff with a basic understanding of hearing loss and its implications for communication and learning in a postsecondary setting. PEPNet, is the national collaboration of the four Regional Postsecondary Education Centers for Individuals who are Deaf and Hard of Hearing. The Centers are supported by contracts with the U.S. Department of Education, Office of Special Education and Rehabilitative Services. The goal of PEPNet is to assist postsecondary institutions across the nation to attract and effectively serve individuals who are Deaf and Hard of Hearing.

Introduction

The Postsecondary Education Programs Network (PEPNet) now offers one hour of multimedia web-based training on the PEPNet web site at www.pepnet.org. The training, entitled *Orientation to Serving College Students Who are Deaf or Hard of Hearing*, is designed for postsecondary education professionals who are serving students who are deaf or hard of hearing. Others who may benefit from completion of the training include prospective employers of deaf and hard of hearing students and beginning students preparing for careers in deaf education, audiology, communication disorders, rehabilitation, or sign language interpreting. The training is offered at no charge, and individuals who complete the training may download and print an official certificate of completion issued by PEPNet.

Instructional Goal

The instructional goal of the project is to provide postsecondary administrators, faculty, and staff with a basic understanding of hearing loss and its implications for communication and learning in a postsecondary setting. Upon completion of the course individuals will be able to: 1) define basic terms and concepts related to deafness and hearing loss, 2) Explain how deafness and hearing loss influence people's life experiences, 3) identify languages and communication strategies used by people who are deaf and hard of hearing 4) apply skills for communicating with students who are deaf or hard of hearing, 5) describe the services available for students who are deaf and hard of hearing and 6) adapt instruction to accommodate the needs of students who are deaf and hard of hearing.

PEPNet

PEPNet, is the national collaboration of the four Regional Postsecondary Education Centers for Individuals who are Deaf and Hard of Hearing. The Centers are supported by contracts with the U.S. Department of Education, Office of Special Education and Rehabilitative Services. The goal of PEPNet is to assist postsecondary institutions across the nation to attract and effectively serve individuals who are Deaf and Hard of Hearing. The training was developed with collaborative participation of a team of content experts from each of the four Centers:

- Debra Wilcox Hsu, Dissemination Coordinator (team leader) and David Buchkoski, Training Coordinator, Midwest Center for Postsecondary Outreach (MCPO) at St. Paul Technical College, St. Paul, Minnesota
- Charley Tiggs, Project Field Specialist, Northeast Region is served by the Northeast Technical Assistance Center (NETAC), located at the Rochester Institute of Technology in Rochester, New York.
- Marcia Kolvitz, Associate Director, Postsecondary Education Consortium (PEC) located at the University of Tennessee at Knoxville
- Allisun Kale, In-Service Training Specialist and Gary Sanderson, Outreach Program Coordinator, Western Region Outreach Center and Consortia (WROCC) located at the National Center on Deafness at California State University, Northridge.

The PEPNet content expert team contracted with Seward Leaarning Systems, Inc in Minneapolis, Minnesota, for the design, development and programming of the web-based training. The training module was available on-line within six months of the inception of the project. Team members worked together during those months through one face-to-face meeting and many telephone conference calls and chat meetings.

Role of Web-based Distance Learning

The four Regional Postsecondary Education Centers for Individuals who are Deaf and Hard of Hearing were created to ensure that every postsecondary institution in the United States could easily access the technical assistance and outreach services that the Centers provide. The Centers serve over 10,000 colleges, universities, proprietary schools, and community based rehabilitation centers throughout the United States. Multimedia web-based distance learning is an ideal training and dissemination tool for organizations like PEPNet which provide outreach and training under the following conditions:

- Large populations - PEPNet serves over 10,000 postsecondary institutions.
- Geographically dispersed - PEPNet serves postsecondary institutions in rural and urban areas in every state and territory of the United States
- Continuous stream of trainees - PEPNet serves a continuous stream of professionals in postsecondary institutions.
- Learners at various levels - PEPNet serves professionals with varying levels of experience and knowledge about working with students who are deaf or hard of hearing.
- Stable content style and scope - *Orientation to Serving College Students who are Deaf or Hard of Hearing* content is stable and universally needed to effectively serve students.
- Accountability is required - PEPNet is accountable to the US Department of Education to provide training to professionals in postsecondary education and to document the training. Interactive web-based delivery of PEPNet training will allow for electronic tracking of completed training and automated credentialing of training for professionals in postsecondary education.

In addition to the collaborative web site and multimedia web-based training, PEPNet offers an on-line Resource Center on the PEPNet web site with thousands of listings of resources related to deafness and hearing loss. For more information about the PEPNet services or to participate in the on-line training visit the PEPNet web site at www.pepnet.org or contact Debra Wilcox Hsu at 651.221.1432 or dwilcox@stp.tec.mn.us.

Academic Information Management: an Open Linking Approach

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Abstract: This paper describes a Web based document management system developed as a Lotus Domino application and the continuing research work of providing users with a variety of link services and agents that enhance the basic content of the system. The system is designed for use by administration personnel in an academic environment taking into account the wide variety of systems and methods already in use. Users do not need to know how to author Web pages as the source material for the system are files produced by common word processors. The system features a number of management tools to complement this concept written into the Domino application. The document management system is complemented by the use of an open linking service to dynamically cross-reference the documents.

Introduction

It is becoming commonplace for academic departments to maintain a Web site of official information for staff and students. The creation and maintenance of such a site is far from trivial. The AIMS (Academic Information Management System) project sets out to make it a very simple matter for the people who create paper documents within a department or organisation to contribute them directly to an automatically generated Web site. Advanced linking technology is used to enhance these online documents with as much relevant information as possible. The AIMS server becomes a fully featured Web-based repository and archive for the information. The user is simply required to provide a minimal amount of information when submitting a word-processed file from a Web form. AIMS has been designed around the concept of making use of the content of files rather than just being a Web-based file store. Users are expected to continue to work as normal on their own machines and submit finished versions of documents to AIMS.

An external link service enhances AIMS Web pages by embedding links on words or phrases found in AIMS pages. The links are not embedded in the documents on the server but are added to the Web pages on the fly by the link service. For example, a set of links can be automatically created that link staff names and user id's to user's home pages. The link service and other agents attempt to reflect the structure of the department complementing the information contained in the documents.

The AIMS Document Management System

This section contains a summary of the key features of the document management aspects of the system as implemented using a Lotus Domino server. Documents are submitted as actual files using a simple Web form. A small amount of information is required about the document but every effort has been made to make it a quick and easy process to upload a file. A complex LotusScript program manages the creation of a document in the Notes database and conversion of the actual content of the file into the internal Notes format whilst also storing the original file. Numerous formats are supported including Microsoft Word and WordPerfect. This ability to work with the content of a variety of file formats is the main reason why Lotus Domino was chosen as the application development environment for the project. From this database of rich text information the Domino server can generate Web pages on the fly. The overall design is targeted towards making a simple and fast process for puttting normal word-processed documents online with the minimum of effort.

Features of the document management system include :

- Documents are accessed from various generated listings designed for the application.

- Version control is supported. Users can update documents in the system as required. The system maintains the relationships between versions of documents.
- A custom designed search interface allows searching of the document content.
- AIMS stores all original files as well as storing the Notes version of the content.
- Automatic generation of Adobe Acrobat PDF files for all word-processed documents. This allows users to obtain print accurate copies of documents.
- Online editing of document details, future versions of AIMS may allow direct editing of the document content using a Java applet.
- Special facilities for large documents. These are stored in sections with a special table of contents document defining the relationship between them. This concept has been extended to allow users to define collections of documents such as 'All the minutes for 1997'. This is implemented using dynamic database lookups so the collections are continuously updated. The code library for this could be used in other Lotus Notes applications.

AIMS are now in use within the author's department and being evaluated by a number of others at Southampton and other UK Universities. Currently there are three Domino servers running 5 separate AIMS databases.

The Application of Open Linking

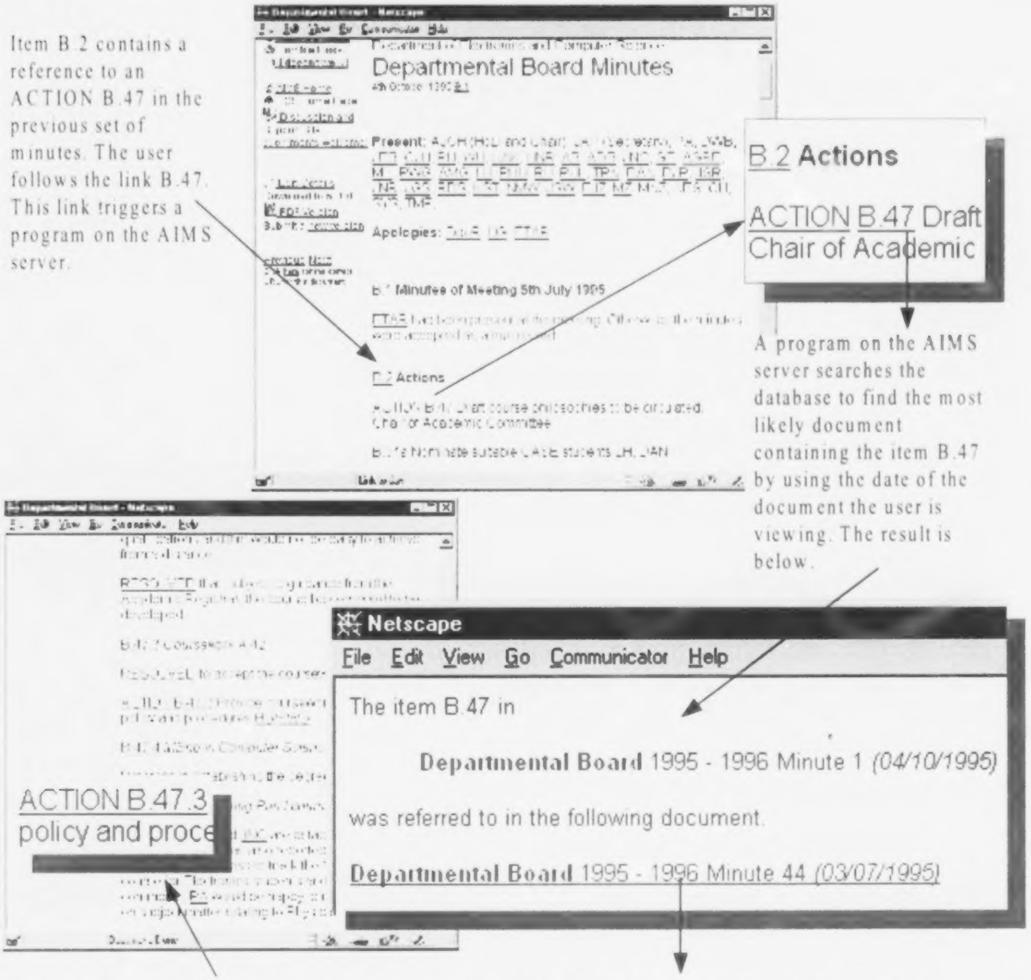
The consequence of the AIMS design is that documents do not contain embedded links in the way that a normal Web site would. The initial research goal of the project was to provide useful links on this content in a way that is easy to maintain. This is achieved by making use of an open hypermedia link service developed within the group. Over time the service has been implemented in two flavours though both work along similar principles. The first is the Distributed Links Service (DLS) [Carr et al 1995] [Carr et al 1998] [Carr et al 1998a] [Hill et al 1995] developed within the group mainly funded by the Open Journals Project [Hitchcock et al 1997] [Hitchcock et al 1998]. The commercial version, Webcosm, is developed by Multicosm Ltd, a company originally founded to exploit the Microcosm [Fountain et al 1990] system. Each brings differing advantages for the AIMS project. Webcosm has a larger feature count and will be used when the linking service is made available to users of AIMS whereas the DLS source is controlled by the group and the system can be altered at a low level for experimental purposes.

The link service is implemented as a Web proxy. The user configures their browser to use the link service as their Web proxy. When the browser requests a page it will ask the link service for the page. The link service will retrieve the page from the server (AIMS) and annotate the HTML with extra links before passing the enhanced Web page back to the user's browser. Links are stored on the link server in link databases or linkbases. An entry in a linkbase consists of the word or phrase to make an anchor, the destination URL and a description of the link. When the link service is in use any occurrence of the word or phrase in pages the user views will become a link to the destination document even though this link is not in the original Web page. This is a generic or glossary link as first implemented in the Microcosm hypermedia system. An example of an entry in a linkbase would be to link the acronym of a research group in the department to the home page of the research group. A link of type local restricts the anchor to only occur in a single document.

The main linkbases in use with AIMS are a set of links for all undergraduate courses to the relevant course page, a large linkbase linking user id's and user names to home pages and a linkbase with a variety of acronyms and other useful words or phrases. The key advantage of using the system is ease of maintenance. If the home page of our research group changes then the link can be updated in one simple action by altering the entry in the appropriate linkbase. The first goal of using the link service with AIMS is to author linkbases of official terms and definitions for the department with effort going towards automating link creation at every opportunity.

Linking Items in Minutes

A more advanced application of the linking service is to try and make more use of the structure of the minutes stored in AIMS. In the diagram below [Fig. 1] the Distributed Links Service has been modified in an experiment to link the items and actions in minutes together. The minutes of the Department Board of Electronics and Computer Science contain item numbers of the form B.n where n is a number. Frequently items in minutes will be following on from Actions and Items in previous editions of the minutes. The Distributed Links Service has been used to link together these item numbers enabling readers to follow the trails of issues back through time.



Item B.2 contains a reference to an ACTION B.47 in the previous set of minutes. The user follows the link B.47. This link triggers a program on the AIMS server.

Departmental Board Minutes

B.2 Actions

ACTION B.47 Draft Chair of Academic

A program on the AIMS server searches the database to find the most likely document containing the item B.47 by using the date of the document the user is viewing. The result is below.

The item B.47 in

Departmental Board 1995 - 1996 Minute 1 *(04/10/1995)*

was referred to in the following document.

Departmental Board 1995 - 1996 Minute 44 *(03/07/1995)*

ACTION B.47.3 policy and proce

The server returns a link to the referred document. In the body of this document is the Action B.47.3

Figure 1: Using the Distributed Links Service to link items in minutes allowing the user to follow trails of issues back through time.

This example needs further investigation to ensure that the techniques apply to more generic document types and are not relevant to just a few documents that match a certain pattern. For pattern matching algorithms to be more successful users must be trained to be accurate in their use of the numbering schema. Users submitting documents could be constrained in what they can enter in the fields or more fields could be added to describe the document in more detail. This will quickly discourage users especially if they lack confidence and are concerned that their categorisation would be considered 'incorrect'.

Link Authoring From A Browser

Webcosm ships with a Java link editor form. A more preferable solution would be to create links whilst viewing the documents. Microsoft Internet Explorer 4 allows users to add items to the context menu allowing the creation of a simple authoring tool. The user opens the destination and selects the appropriate word in the text to use as

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the anchor. An additional entry on the context (or right click) menu 'Create Generic Link' uses Javascript to create a filled in form for submission directly to the Webcosm server.

This experimental application has enough functionality to allow users to directly author links between documents. The links will also have a high probability of still being relevant as new versions of documents are added. If the destination document is updated then the link will point to the new version of the document. If a document containing an anchor is updated then the link will survive if the same word or word-pair still occurs in the content of the new version. Whether these links are still relevant to the content is a more complicated issue. If the experiment is pursued further then this will need to be addressed.

Alternative Ways of Using the Link Service

Experience of the use of Webcosm and the DLS in a number of projects have shown that the implementation of the service as a Web proxy has a number of disadvantages. Users may not know how to set up a proxy or may not be allowed to make use of a proxy. The use of firewalls may restrict its operation. When in use the service will alter all documents the user reads no matter whether the links are in context or not. This particular issue has been addressed by the DLS which allows a linkbase to be used for a limited URL domain.

Alternative implementations do exist. Webcosm has also been developed as a plug-in library using the NSAPI interface for Apache Web servers. The link service is a library resident on the Web server and alters Web pages before the Web server delivers them to the browser. The consequence is that only documents on the server are enhanced. This is not a problem for AIMS and could be seen as a definite advantage. A similar low level interface to the Domino Web server does not currently exist though there are other methods for achieving a similar effect. Webcosm is implemented as a Web proxy component and a link server engine. It is possible to write programs that communicate directly with the link server. Within the AIMS application programs have been written that run every time a document is requested from the server. Java code asks the link server for the links for that particular document when required. The link service returns just the list of links it would have placed into the document and these links are processed and placed into a field in the document just before the Domino server renders and delivers the document. The links appear in the margin as a list of recommended sites for the user to view. Though the links are not being embedded in position in the main flow of the document the links are being generated on demand and in context depending on the users chosen linkbases.

The next step has been to try a process of pre-compilation of links. A system has been devised that can 'pull' the body of AIMS documents through the link service which adds the appropriate links. This HTML representation is stored in the database and served to users who are unaware that the main portion of the document is not actually being generated on demand. Though this has the obvious disadvantage that links are not being created on the fly the system now looks and feels like a normal Web site to users. This will make it easy to develop a system for creating point to point links between documents. The envisaged procedure would be for the link author to update documents overnight as required. This is still in development and no conclusions have yet to be drawn from its use.

Beyond Generic Links

The limitations of generic links soon become apparent. Too many links will overwhelm the user and be a distraction. This problem has been addressed by work done for the Open Journals project by modifying the DLS. The DLS has a concept of link priority schemes, different links can be given a priority by their author and the system can colour the links accordingly or even not display certain priority levels of links. Using pattern matching to create links in text is shown by the example of linking Board Minutes to be a promising way to find more link anchors with less explicit link authoring. Another application of such techniques would be to help with recognising names of people within documents though such techniques are much harder to implement. Pattern matching algorithms to solve this problem would need to be complicated compromising the performance of the service and slowing the access times of documents. There needs to be an alternative approach to the proxy synchronously processing each page. See [Carr et al 1998a]. The proxy could farm out the processing of documents to agents that would each examine the document and try to provide the user with useful information and links. These results would need to be delivered to the browser separately from the document causing a number of implementation problems..

An important implementation issue is how to create useful links for the documents. Some linkbases are automatically generated by extracting data from other online systems such as the staff database. This is useful but is limited to specific topics. Another method could be to require users to supply potential keywords and metadata for a document. This places unwanted demands on users and would be very difficult to implement. A more interesting method is to use some system that can understand the content of the documents and generate keywords automatically. Such a system, Refindment, has been developed by Multicosm and is being tested with AIMS.

Related Work

Other open hypermedia systems have evolved to encompass the Web in some respect and offer enhanced Web pages. Chimera [Anderson et al 1994] has been integrated with the Web in a number of ways [Anderson et al 1995]. One was to use a Java applet inserted into all Web pages that gave independent access to the information in the Chimera store. Another method was to write a CGI gateway from Web server to Chimera server allowing a browser access to the Chimera structured information. Hyperwave [Hyperwave 1999], now marketed as an advanced Web server, started life as an open hypermedia system Hyper-G [Andrews et al 1995], [Maurer 1996]. In it links are first class objects stored separately from documents and are also bi-directional. Links are merged into the documents when delivered to the browser. Webvise [Grønbæck et al 1999] has evolved from the DHM/WWW integration project into an enhanced Web service offering contexts, links, annotations and guided tours stored in external databases. Users can collaboratively create links and other hypermedia content using the Microsoft Internet Explorer 4 Browser utilising COM technology. The same group is now drawing on the lessons of many of the systems listed here and working on the ARAKNE framework [Bouvin 1999], [Bouvin 1999a]. This is an object-oriented component-based, three layer model aimed at providing Web augmentation tools a unified access to structure servers, proxies and Web browsers.

The Memoir [DeRoure 1998] project used an open architecture including proxies and link services to support researchers working with vast quantities of distributed information. The system not only used the DLS link services but also supported the trail as a first class object. Users could record their trails through documents whilst pursuing a particular task and the system could match trails thus connecting users with similar interests.

A number of systems have used Web server or proxy based methods to provide annotation services for applications such as discussion groups. Critsuite [Critsuite 1999] includes the CritLink link service component that will annotate existing documents with links. The author's first mediator was Shodouka [Shodouka 1999], this proxy could render Japanese Web pages as images on Web browsers that did not support the Japanese language.

The Wide Area Information Browsing Assistance (WAIBA) [Brooks et al 1995] project was set up to investigate the use of the Web for collaborative work. One of the underlying technologies developed was transducers [Meeks et al 1996]. Transducers were defined as proxies that alter the message streams between server and browser. A toolkit, STRAND (Stream TRANsDucer) was produced that allowed developers to rapidly build transducers. It was available until recently for free use as part of WebWare. Another architecture for building transducers or intermediaries is WBI [Barrett 1997]. This is a toolkit of Java classes that are currently in use for building a variety of applications. These include a personalisation proxy for a user to run on their own machine that will annotate pages the user reads. A more powerful system is to use a pair of transducers that can convert HTML or XML into other formats to transmit using wireless technology and then convert back at the client. A third use is as a filter for allowing children to use the Web.

Conclusion

We have created a Web based document management system using Lotus Domino with facilities designed for academic as opposed to a large-scale industrial environment. The use of such a flexible development platform now allows us to bring these documents alive for users in ways that are not possible on paper or on a traditional Web site.

All of this research is trying to find as many ways of adding value to the basic content submitted to AIMS. At its most basic AIMS simply stores files originally written on a word processor that were destined to be printed. These electronically frozen documents need to be kept alive by as many means possible to ensure their continuing relevance to the users of the system and to make it easier for people to find the information they need on a daily basis. By making use of the content of these documents and many other live sources of information forms a considerable advantage over the paper versions outweighing the small amount of effort required to submit documents into AIMS.

References

[Anderson 1997] Anderson, K. (1997). Integrating Open Hypermedia Systems with the World Wide Web. *The Eighth ACM Conference on Hypertext and Hypermedia.*

[Anderson et al 1994] Anderson, K., Taylor, R. N., Whitehead, J. (1994). Chimera: Hypertext for heterogeneous software environments. *European Conference on Hypermedia Technology (ECHT94)*, pp. 97-107, Edinburgh, Scotland.

[Andrews et al 1995] Andrews, K., Kappe, F. and Maurer, H., (1995) Serving Information to the Web with Hyper-G. *The fourth World Wide Web conference.*

[Barrett 1997] Barrett, R., Maglio, P. P., Kellem, D. C. (1997). How to personalise the Web. *Conference on Human Factors in Computing (CHI97)*, Atlanta, Georgia, USA, Mar. 1997.

[Bouvin 1999] Bouvin, N. (1999). Unifying Strategies for Web Augmentation. *The Tenth ACM Conference on Hypertext and Hypermedia* .

[Bouvin 1999a] Bouvin, N., Schade, R. (1999). Integrating Temporal Media and Open Hypermedia on the World Wide Web. *The Eighth International World Wide Web Conference*, Toronto, Canada.

[Brooks et al 1995] Brooks, C., M. Mazer, S. Meeks and J. Miller (1995). Application-Specific Proxy Servers as HTTP Stream Transducers. *The Web Journal* 1, 1, 539-548, OReilly and Associates.

[Carr et al 1995] Carr, L., De Roure, D., Hall, W. and Hill, G. (1995). The Distributed Link Service: A Tool for Publishers, Authors and Readers. *The Web Journal* 1, 1, 647-656, OReilly and Associates.

[Carr et al 1998] Carr, L., De Roure, D., Hall, W. and Davis, H. (1998). Implementing an Open Link Service for the World Wide Web. *The World Wide Web Journal* 1, 2, 1998, OReilly and Associates.

[Carr et al 1998a] Carr, L., Hall, W., Hitchcock, S. (1998). Link Services or Link Agents ? *Ninth ACM Conference on Hypertext and Hypermedia.*

[Critsuite 1999] Critsuite Critical Discussion Tools for the Web. The Foresight Institute. http://crit.org/http://crit.org/index.html.

[DeRoure 1998] DeRoure, D., Hall, W., Reich, S., Pirakis, A., Hill, G. and Stairmand, M. (1998). An Open Architecture for Supporting Collaboration on the Web. *IEEE Seventh Internation Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises.*

[Fountain et al 1990] Fountain A., Hall W., Heath I. and Davis H. (1990). Microcosm: an Open Model With Dynamic Linking. *Hypertext: Concepts, Systems and Applications (Proceedings of the European Conference on Hypertext*, INRIA, France, November 1990) 298 – 311.

[Grønbæck et al 1999] Grønbæck, K., Sloth, L., and Ørbæck, P. (1999). Webvise: Browser and proxy support for open hypermedia structuring mechanisms of the WWW. *The Eighth International World Wide Web Conference*, Toronto, Canada.

[Hill et al 1995] Hill, G., Hall, W., DeRoure, D. and Carr, L. (1995). Applying Open Hypertext Principles to the WWW. *International Workshop on Hypermedia Design*, Montpellier, France, 1-2 June 1995.

[Hitchcock et al 1997] Hitchcock, S., Carr, L., Harris, S., Hey, J. (1997). Citation linking: improving access to online journals. In *Proceedings of Second ACM Conference on Digital Libraries*, Philadelphia, pp.115-122.

[Hitchcock et al 1998] Hitchcock, S., Carr, L., Hall, W., Harris, S., Probets, S., Evans, D. and Brailsford, D. (1998). Linking electronic journals: Lessons from the Open Journal project. *D-Lib Magazine*, December 1998.

[Hyperwave 1999] Hyperwave Information Management server. Hyperwave GmbH. http://www.hyperwave.com/

[Lotus Notes 1999] Lotus Notes workflow and information management system. Lotus Development Corporation. http://www.notes.net/

[Maurer 1996] Maurer, H., Ed. (1996). Hyper-G now Hyperwave: the next generation Web solution. Addison-Wesley.

[Meeks et al 1996] Meeks S., Brooks C. and Mazer M. (1996). Transducers and Associates: Circumventing Limitations of the World Wide Web. Paper presented at *etaCOM (Emerging Technologies and Applications in Communications) '96 conference*, Portland, Oregon.

[Shodouka 1999] Shodouka enables Japanese text to be read on any Web browser. The Shodouka Corporation. http://www.shodouka.com/

[Webcosm 1999] Webcosm is a component used in the knowledge management products produced by Multicosm Ltd. http://www.multicosm.com/

PASSENGER: A CSCL Tool for Spatially Distributed Software-Engineering

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Abstract: In this paper we will describe the Passenger-Concept and our motivation for applying new media to support a Software-Engineering Course. For this approach the international degree course „Computer Science &Communication Engineering", which was first offered at Gerhard Mercator University Duisburg during the winter semester 1997 plays an important role. The development and setup of the new international degree course are described in (Hunger, 1998). With the usage of new media and communication technologies it should be easier for foreign students to follow the studies in Germany. Further, it can give students the ability to take part in the Software-Engineering Course during their abroad year of the studying. Thus students not only have the ability of shortening their study-time, but also have the chance of obtaining knowledge in systems known as Compuer Supported Collaborative Working (CSCW) Environments (Kremar, 1991).

1. Introduction

Nowadays, industrial Software-Engineering has the meaning of developing high-quality complex Software-Systems with a given budget and a decreasing time-to-market span. One of the main problems result from the fact that used methods for modern Software-Engineering are often not setup for those complex Software-Systems. One must realize that software belongs to our everyday life and that one could be confronted with problems resulting from defective software. Examples for these incidents can be found in (Nuseibeh, 1997) and (Leveson & Turner, 1993). The worldwide extension of the data networks and the continuing globalization added another component to industrial Software-Engineering: the development in worldwide distributed teams. Based on this scenario, new concepts and tools for the Software-Engineering-Education are developed.

The presentation of the course Software-Engineering is a combination of two hours of lecture and six hours of practical training per week. The Software-Engineering syllabus is orientated on the basics of classical Software-Engineering and the methods and models used in this area. The practical training aims at applying subject matters which were imparted in the lecture in a realistic scenario. Thus, at the beginning of the semester project-teams are formed, which will consist of four students. During the semester the teams will experience the entire life cycle of Software-Engineering. In order to divide up the life cycle into phases the Waterfall-Model (Boehm, 1978) is applied. The project-teams meet once a week at a certain time for two hours in a computerroom of the university. During this time tutors are available. One tutor is responsible for several groups. His job is to support the project-teams if necessary and to check the progress of the teamwork. Furthermore, the tutors offer consulting hours during the week. This offer is optional. The students can arrange the remaining four hours of the practical training on their own. The task has to be completed within a period of 11 weeks, during which time regular interim reports have to be submitted within set deadlines to the designated tutor. So far, no Case-Tools have been put into usage. Problems given in the past were amongst others simulating an elevator control for a high-rise or the simulation of a car-production-plant.

2. The Passenger Concept

The above described organization of the Software Engineering lab is supposed to be extended by aspects of distributed teams in the future. This scenario has long become reality in the Software-Engineering industry and is well-known in the literature (Nakatani, Nishida and Takeda, 1991). Following this scenario, the Passenger-Concept defines four modules for the conduction of the Software-Engineering course: the Passenger-

CD to support the lecture, the Passenger Case & Video Tool to conduct the practical training in a distributed manner, the Passenger Web Site to solve organizational tasks and Passenger –Doc to versionize the documents automatically

In the following sections we will focus on the development of the Passenger Case & Video Tools. A description of the other part projects can be found in (Hunger & Werner, 1998a). The implementation of the concept requires efficient tools to transfer the knowledge of the lecture and conduct the practical training in a distributed manner. A condition for conducting the practical training is the availability of tools for a synchronous communication and for common document processing. For this purpose, a Software-Engineering-Case-Tool is needed. Altogether the following modules have to be realized: 1st. Synchronous communication tools for text, audio and video, 2nd a session handling to control the synchronous sessions, 3rd Protocol stacks to meet the required network services, 4th a Software-Engineering-Case-Tool for common document processing, 5th a control system to handle different kinds of permissions, 6th a version control system for the common documents.

Commercial available videoconference tools e.g. Microsoft-Netmeeting, CUSeeMe or others do not offer the above mentioned functions. Some systems support the functions mentioned in point 1, 2 and 3 and especially the Whiteboard included in Microsoft Netmeeting meets some requirements of the functions mentioned in point 4. But none of these systems support the absolutely essential support of the students during a session. Neither a support for the processing of the common documents is offered by these systems. Therefore commercial available videoconference tools can not be considered for the conduction of the practical training.

3. Passenger Case & Video Tool

The scenario of distributed Software-Engineering places additional demands on the students. Apart from learning the actual contents and how to work in a team, the following three aspects will lead to a steeper learning curve.

a) The students are not used to applying Software-Engineering Case-Tools.

The application of Software-Engineering-Case-Tools requires additional time of the students because they have to learn how to use the Case Tools. The Case-Tool learnability depends essentially on its complexity (Boloix & Robillard 1998). Beyond that, modern Case-Tools perform a consistency check according to the rules of the design method they are based on. But this work however should be conducted by the students. For the reasons specified above we have decided to develop our own Software-Engineering-Case-Tool. This Case-Tool will contain the modelling levels and symbols defined in the Ward & Mellor approach but no rules for a consistency check will be included. Thereby the Case-Tool is reduced to a custom-made graphic design tool. The design of the Case-Tool interfaces takes place in a way that other Software-Engineering-Case-Tools based on different design methods can also be integrated. later. If beyond that, these Case-Tools can also perform a consistency check then the CSCL-Tool becomes a CSCW-Tool. This is important to not limit the application of the Passenger case&Video Tool to the practical training.

b) For the students, discussing by the means of video conferencing represents a new form of communication.

A preliminary study was conducted to assess the possibilities and limitations of telecooperation capable software for the usage in a practical training in Software-Engineering. One of the most important results of this study is the demand for a mechanism which should portray a face to face discussion through the computer as far as possible. Methods for the set up and intensification of relationship aspects are also part of this. More results of this study are published in (Hunger & Werner, 1998b).

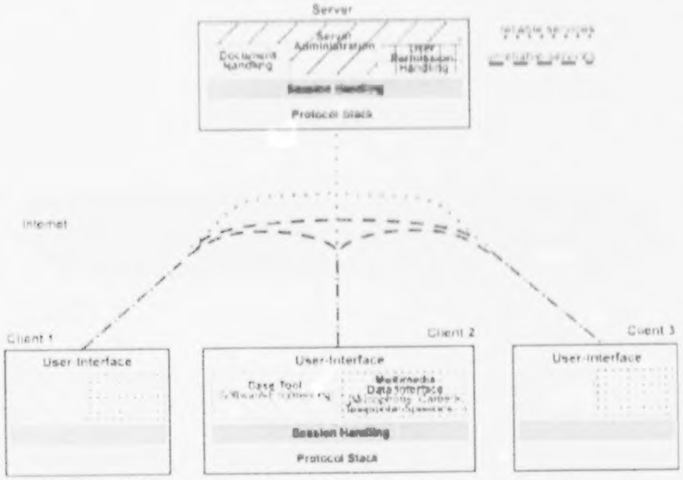
c) Common document processing over a network is new to the students.

During the practical training two basic working methods are conceivable. On the one hand common synchronous processing of a document and asynchronous processing of the documents by individual students on the other. This results in a necessity to administrate the documents at a central place. During synchronous sessions in particular access to the documents has to be regulated. Furthermore the students have to be relieved from the process of Document-Versionizing. This is true for both synchronous and asynchronous forms of document processing.

4. System Architecture

The development of the Passenger Case & Video Tools requires not only the development of a user interface from a didactical and a psychological point of view and the integration of a Case-Tool, but also mechanisms for multimedia data exchange in order to make working on a network and the transport of data possible. In this section we start presenting the general system architecture and then go on to discussing the resulting communication requirements. The user interface is presented in the next section.

The Passenger Case & Video concept sees windows based systems as its target platform and the global internet as its transport medium. Communication takes place over both reliable and unreliable services. Fig. 1 shows the system architecture of the Passenger Case & Video Tools for the technical implementation of it's communication.


Server
Server Administration
Document Handling
User Permission Handling
Session Handling
Protocol Stack
reliable services
unreliable services
Internet
Client 1
User Interface
Client 2
User-Interface
Case Tool
Software Engineering
Multimedia Data Interface
Microphone, Camera, Keyboard, Speakers
Session Handling
Protocol Stack
Client 3
User-Interface

For the clients the multimedia data interface represents the interface to the input and output peripherals like keyboard, mouse, video camera, speaker and monitor. The Case-Tool is used for common software development. The current session is controlled by the session handling module. The protocol stack handles incoming and outgoing data and resource reservations. During the conceptional considerations of the Passenger-System-Architecture, different possibilities for the data transfer were discussed. As a result of the discussion several methods of data transfer have been implemented: several unicast-connections for client/server-communications and several multicast-connections for interclient-communications.

Furthermore, Fig 1 shows the requirements which individual connections place upon a service. Client/Server connections require reliable services, inter-client connections on the other hand only require unreliable services, but a guaranteed band width and delay. In order to achieve these guaranteed quality-of-service we make use of resource reservation. Both protocol stack and session handling modules also exist with corresponding tasks for the server. The session handling module administrates the global session variables. The document handling and user permission handling modules are there to guarantee the conflict free access to the distributed system resources. The server administration module administrates not only the server but also the groups. Corresponding modules on the server and clients are represented by using the same hatching in Fig.1. A session starts with the participants logging themselves into the server. After that, a video conference is co-ordinated by the session handling. During the video conference, real-time data (audio and video) is not routed through the session server in order to reduce long signal and processing delays. The interchange of this data results directly. Parallel to the interclient communication, several client/server connections exist for exchanging document data and all over session relevant information.In the sense of the system architecture even the tutor is a "normal" client.

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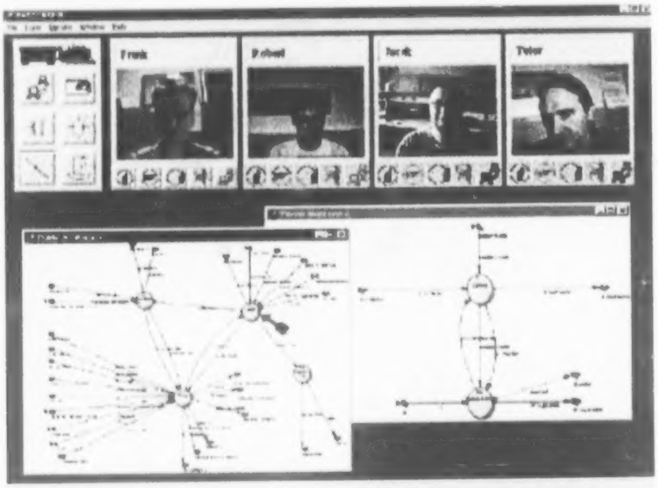
For the realisation of the above described architecture, a suitable protocol stack has to be developed. In a first step only implementations of standardized protocols which are currently available, or which will become available in the near future are used. The protocol stack is based on the Internet Protocol Version 6 (Deering & Hinden, 1998) for the realisation of multicast connections in the Internet, associated with the Resource ReSerVation Protocol (RSVP) (Braden, Zhang, Berson, Herzog, Jamin, 1997) for quality-of-service support. The Real-Time Transport Protocol (RTP) (Schulzrinne, Casner, Frederick, Jacobson, 1996) is used to meet the multicast and real-time requirements of the Audio/ Video Conference. The actual data transport is carried out, using the connectionless User Datagram Protocol (UDP). Parallel to this the classic connection orientated and reliable Transmission Control Protocol (TCP) above IPv6 is used to transmit signalling-, chat- and document data. Measures to increase performance arise in the first step by strictly splitting the connection types in reliable and unreliable services and implement them in several parallel protocol stacks. Measures like adapting certain protocols should be considered later.

5. The Client User Interface

Working in a team, dividing up the given task into subtasks, discussing provisional results and integrating first results afterwards, already require discipline of the students without using Video-Conference-Tools and the implicit usage of a process model. The usage of Video-Conference-Tools also requires that students work in a completely new scenario. Thus interface design obtains an outstanding meaning. The client-user-interface contains video screens of each member and a case-tool in a public window for the common process on the outline documents. Fig.2 shows the user interface of the Client-Software.



Each member has the same view of the window according to the WYSIWIS-principle, but only one of them can alter the document at a certain time. A telepointer serves to elucidate and to present facts. Each member is also equipped with a private working window for trying out ideas. A chat window was implemented so the conference could be ended simultaneously in case of bad transfer circumstances.

Other specific features of the user interface result from the above mentioned demands to support a natural face-to-face discussion and to setup and intensify relationship aspects. These demands take following implementation-measures into account neither size nor position of the video screens can be changed, none of the video screens can be covered by another video screen, the members always appear in the same video-screens and a specific permission-control supports the students during the synchronous sessions.

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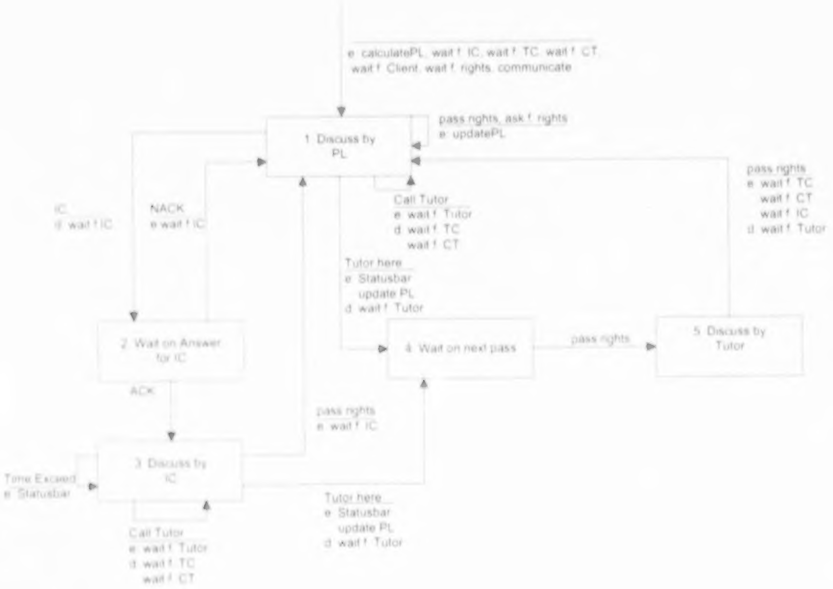
6. Permission Control

The permission-control is part of the user-permission-handling which is implemented on the server and handles the access to the public window and the documents. Furthermore it coordinates the course of communication through an administration of different kinds of permissions, e.g. permissions to speak, permissions to alter the documents. Therefore, the permission list (PL) is an essential part of the permission-control. The PL to handle the permissions to speak can have three possible entries. The actual spokesperson is followed by the next two clients who request to speak. Each demand of the permissions and each passing of the permissions result in updating this list. Important is that the list never shows two equal entries. Thus two members can not exclude the third person from the discussion. According to the fact that the list is automatically updated after every pass-right the system can never reach the state of a deadlock, even if the third person did not request the permission to speak. Fig. 3 shows the state-transistion-diagram of this part of the user-permission-handling.


e: calculatePL, wait f. IC, wait f. TC, wait f. CT,
wait f. Client, wait f. rights, communicate
1. Discuss by PL
pass rights, ask f. rights
e: updatePL
IC
d: wait f. IC
NACK
e wait f. IC
Call Tutor
e: wait f. Tutor
d: wait f. TC
wait f. CT
pass rights
e: wait f. TC
wait f. CT
wait f. IC
d: wait f. Tutor
Tutor here
e: Statusbar
update PL
d: wait f. Tutor
2. Wait on Answer for IC
4. Wait on next pass
pass rights
5. Discuss by Tutor
ACK
pass rights
e: wait f. IC
3. Discuss by IC
Time Exceed
e: Statusbar
Tutor here
e: Statusbar
update PL
d: wait f. Tutor
Call Tutor
e: wait f. Tutor
d: wait f. TC
wait f. CT

In state 1 (Discuss by PL) all parallel processes for accepting client inputs are enabled. A user can always ask for all permissions (ask for rights in Fig. 3) or pass all permissions to the next user in the permission list (pass rights in Fig. 3). Both cases lead to an update of the permission list but not to a new state. A new state can only be reached by ending the communication, requesting an intermediate call or by calling the tutor.

An intermediate call represents a specific feature during the communication. A user can request an intermediate call at any time, while being in a discussion (state 1). Then the spokesperson is notified on a statusbar, that client x wants to make an intermediate remark. At the same time the system goes over into state 2 (wait on answer) without making changes in the PL. The spokesperson can reject the request using -NACK-, which would make the system return to state 1. The discussion would then be continued by the spokesperson. If the spokesperson accepts the intermediate call though, he has to use -ACK-. In this case the system changes to state 3 (Discuss by Intermediate Call). This does not change the permission list either. Since the intermediate caller has not the right to accept other intermediate calls, the process wait for intermediate call is disabled. That way it is ensured that the course of discussion will not get out of control. The intermediate caller receives all rights for working with the documents, but his time is limited. After two minutes a reminder appears on the statusbar, requesting to give the rights back to the previous spokesperson. If he does so, the discussion will be continued according to the PL.

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Every user can call the tutor anytime using the call tutor function. This does not cause changes of the states , it only enables the process wait for tutor. This protects the system from a deadlock in case the tutor is not in his office. The system goes on to state 4 (wait on next pass) as soon as the tutor logs in. After the tutor logged in, the members are notified on the statusbar and the PL is updated. The tutor is set on the top of the PL and the discussion member who called the tutor is set to be the next. The third place stays unoccupied, one of the other members can apply for it though. With the next pass of the rights the system goes on to state 5 (discuss by Tutor), whereas the tutor is the spokesperson with all permissions.

Should the tutor login without any explicit request of the members, the system goes over into state 4. In this case the tutor is also set on the top of the PL and he will receive all permissions after the next passing of rights. In this case the other entries in the PL stay empty.

7. Summary and Outlook

This paper presented a new concept concerning the University-Education on the subject Software-Engineering. Based on this concept new tools were developed and implemented. The essential innovations of the presented idea in comparison with known concepts are in this case

- integrating different tools under a common user interface,
- the way in which face-to-face discussions are taken into account
- the development and integration of case tools especially for the usage in a practical training,
- the assembly of parallel protocol stacks with usage of given protocol structures.

The implementation of the CD for the lectures and the implementation of the client-user-interface took place in 1998. Current work deals with the implementation of the protokol stacks and the server and an outline of the software-engineering case tools. The first version of the communication tools is expected during the summer of 1999. Concerning the practical training of Software-Engineering, the tools are supposed to be put into practice during the summer-semester 2000

8. References

Boehm, B.W. (1978) *Characteristics of software quality* North-Holland Publ.

Boloix, G., Robillard, P.N. (1998) Case tool learnability in a software engineering course In *IEEE Transactions on Education,* Vol. 41, No.3, August 1998, 185-193

Braden, R. Zhang, L.; Berson, S.; Herzog, S.; Jamin, S. (1997) Resource ReSerVation Protocol (KSVP) Version 1, Functional Specification, RFC 2205.

Deering, S. & Hinden, R. (1998). Internet Protocol, Version 6 (IPv6) Specification, RFC 2460.

Hunger, A. (1998) The Concepts of the Internationally Orientated Degree Course ,Computer Science and Communications Engineering' *Proceedings of the International Conference on Engineering Education 1998,* August 17-20, Rio de Janeiro

Hunger, A. & Werner, S. (1998a) A Course Curricalum and a Multimedia Concept for an internationally orientated Degree Course. In *Proceedings of the CATE '98),* IASTED/ACTA Press, *25-28.*

Hunger, A. & Werner, S. (1998b) Possibilities and Limitations of a Computer Supported Cooperative Learning Environment within a Spatially Distributed Practical Training. In *Proceedings of the Euromedia '98,* SCS Publishing, *235-237.*

Kremar, H. (1991). Computer Supported Cooperative Work -State of the Art. In *Proceedings of the Fourth International Conference on Human-Computer Interaction,* New York, Elsevier, 1113-1117.

Leveson, N.G., Turner, C. (1993) An investigation of the Therac-25 accidents *IEEE Computer, July 1993,* 18-41

Nakatani, M., Nishida, S., Takeda, S. (1991). Group Communication Support System for Software Development Projects based on trouble communication model. In *Proceedings of the Fourth International Conference on Human-Computer Interaction,* New York, Elsevier. 961-966.

Nuseibeh, B. (1997) "Ariane 5: Who dunnit" *IEEE Software May/June 1997,* 15-16

Schulzrinne H.; Casner, S.; Frederick, R.; Jacobson, V. (1996) "RTP: A Transport Protocol for Real-Time Applications", Specification RFC 1889; January 1996

A Data Model for Information Extraction from the Web

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Abstract: The enormous amount of information available through the World Wide Web, that are of possible interest for an organization or a workgroup, requires the development of effective tools for extracting and summarizing relevant data from Web sources.
In this paper we present a Web data model and a query language that allows for simple implementation of wrappers extracting specified data from a set of Web pages.

1. Introduction

The amount of data available through the World Wide Web that are of possible interest for an organization or a workgroup is constantly growing. The World Wide Web can be considered as a huge collection of possible interesting information sources and, in fact, it is a fundamental resource for information discovery.

However it is often the case that such information are not easy to be automatically accessed and cataloged. The main reasons are: (i) information in the World Wide Web are usually presented in a human-oriented way (i.e. they are produced to be understandable by "human eyes"), rather than in a machine-readable format; (ii) information sources are heterogeneous and hence similar data are often presented in different ways by different sources. Therefore, a user has the need of extracting and summarizing relevant information from different sources and of presenting these data in an appropriate format. With this respect, many tools for accessing relevant information have been developed in the last years (see [Iocchi & Nardi 1997,Florescu et al. 1998] for a survey).

Information Extraction from the Web is the process of extracting data from a set of Web pages in order to fill a given data base schema. With respect to other extraction tasks (such as the ones performed within the MUC conferences [MUC]), Web Information Extraction presents two particular features: (i) the input documents are semi-structured: they are neither raw data (full text) nor strictly typed (relational tables), but a structure is provided by HTML or XML tags; (ii) the information sources are heterogenous, i.e. the same kind of information is often presented in different formats.

A Web Information Extraction system receives two kinds of input: (i) a data base schema that represents the information the user wants to retrieve; (ii) a set of information sources (Web sites) containing the data to be extracted. Such a system aims at populating the data base with data extracted from the sources and must provide mechanisms for dealing with semi-structured documents and for accessing heterogeneous information sources. The presence of heterogeneous information sources, whose models are not known a priori, makes scalability to be one of the main features for these systems. In other words, the system must be "easily" programmed for dealing with a large number of different information sources.

An important design element for these systems is the representation techniques used for modelling the data base schema and the information sources. Indeed, this issue permits a classification of approaches to Web Information Extraction.

1. *Customized extraction* is based on writing *customized wrappers* for accessing required data from a given set of information sources (e.g. softbots traversing and parsing the Web pages of a site) [Hammer et al. 1997, Kistler & Marais 1997]. In these systems the models of the data base schema and of the sources are implicitly recorded in the wrapper code.

2. *Automatic wrapper generation* is based on defining a high-level description for generating a customized wrapper [Papakonstantinou et al. 1995b]. In this case the models of the data base schema and of the information sources are explicitly represented.

3. *Automatic extraction* consists in developing a general purpose wrapper generator that is able to build a customized wrapper from (a "simple" translation of) the data base schema given as input (see [De Rosa et al. 1998, Lacroix et al. 1998] for instances). The models of the information sources are not given and thus they must be automatically generated from the actual documents in the sources. Observe that this is a complete automatic process, since the user is not involved in the extraction process.

The classification above highlights a deep relation between the representation technique for modelling information sources and the scalability of the information extraction process. Indeed customized extraction presents a very limited scalability with respect to new information sources, since accessing a new source requires including its description within the wrapper code. On the other hand, automatic wrapper generation allows for describing at a higher level the models of information sources and thus provides a more flexible and powerful tool for effective integration of information. Finally, automatic extraction systems should (ideally) be able to deal with every information sources, thus allowing for the maximum scalability.

In this paper we present a simple Web data model and a query language suitable for automatic generation of customized wrappers based on an explicit representation of the data base schema and the information sources.

2. A data model for the Web

In order to develop effective Web extraction systems, a data model is needed for an explicit representation of the Web information sources and of the data to be retrieved. Classical data models, such as Entity-Relationship and Object Oriented, are not adequate for representing semi-structured data from heterogeneous information sources. Indeed a data model for the Web must consider not only the semantics of data, but also their presentation (formatted layout) in the Web pages. Furthermore, it must provide a framework for modelling at least the following structures: (i) recursive structures; (ii) ordered collection types (tables, lists); (iii) unordered collection types (sets).

In fact, a number of flexible data models for semi-structured data have been proposed [Papakonstantinou et al. 1995, Mendelzon et al. 1997]. We exploit this work for defining a data model that is specific to the representation of Web pages.

2.1 Web-OEM data model

Web-OEM is a simple data model for representing Web pages (specifically HTML pages), that can be considered as a specialization of the Object Exchange Model (OEM) for Web pages [Papakonstantinou et al. 1995].

A Web-OEM object is defined as a tuple *<Label, Values, ObjID>*, where: *Label* is an element of a set specifying the object type (for example some HTML structures can be represented by the set { Page, Table, TableRow, List, Link, Image, Header, Text }); *Values* is a set of pairs < *attribute* = *value* >, with *attribute* denoting an attribute name and *value* being either an integer, a string, an object, or a listofobjects; *ObjID* is the object identifier. A Web-OEM object can also be written as *id:Label<a1=v1,...,an=vn>*.

Web-OEM can be graphically represented as a labeled direct graph, in which each node represents either an object (labeled by its id and its label) or a basic data (a string or an integer value), and each arc, labeled by an *attribute*, represents a pointer to the corresponding object *value*.

Example 1. A Web-OEM data instance for a personal home page is shown below.

```
p1.Page<url="http://w.a.b/c/",title="My home page",structures={i1,t1,l1}>
i1.Image<url="mypicture.gif",alt="My photo">
t1.Table<nrows=2,rows={r1,r2}>
l1.List<nelem=2,elements={k1,k2}>
r1.TableRow<ncols=2,elements{x11,x12}>
r2.TableRow<ncols=2,elements{x21,x22}>
x11.Text<text="Telephone Number">
x12.Text<text="000 0001",format="B">
x21.Text<text="Fax Number">
x22.Text<text="000 0002",format="B">
k1.Link<anc="Publications",ref="pub.html",page=p2>
k2.Link<anc="Preferred Search Engine",ref="http://w.x.y/">
```

Observe that this representation can be generated through a simple parsing process on the Web page. The parser definition does not depend on the page contents and therefore a user can easily implement HTML or XML parsers for associating a Web-OEM representation to a set of Web pages, by considering only the structures of the pages (and not their contents).

2.2 Web-OEM Query Language

In order to extract data from Web pages represented in the Web-OEM model, we define an SQL-like query language, called Web-OEM-QL, that is similar to the OEM query language [Abiteboul et al. 1997].

A query is described by a sentence

SELECT *Fields*
FROM *Objects*
WHERE *Expression*

The clause SELECT specifies a projection over the attributes of retrieved objects. Therefore *Fields* is a list of expression of the form *X.<attribute>*, where *X* is an object variable. The clause FROM consists of a list of expression of the form *<WebElem>:X* where *<WebElem>* is one of the predefined label in the Web-OEM and *X* is an object variable. Finally, the clause WHERE is a boolean expression that determines conditions that must be verified by the retrieved objects.

In order to access nested structures, we define regular expression on the attributes (as in [Abiteboul et al. 1997, Christophides et al. 1996]) by means of two operators ? and * that are interpreted respectively as "any attribute" and "a sequence of zero or more attributes". In this way the expression *p.?* denotes the value of any attribute of object *p*, while *p.** denotes the values of all the possible sequence of attributes of *p*. Finally the notation **[i]** is used for accessing the i-th element within an ordered structure.

Query execution allows for actually extracting data from a Web-OEM description of Web pages. For example, the following query retrieves the boldface texts in the second column of all the tables included in the page with title "My home page".

```
SELECT x.text
FROM Page:p, TableRow:r, Text:x
WHERE p.title="My home page" AND r IN p.structures.* AND
        x = r.elements[1] AND x.format = "B"
```

According to the Web-OEM representation given in the Example 1, the query retrieves the strings:

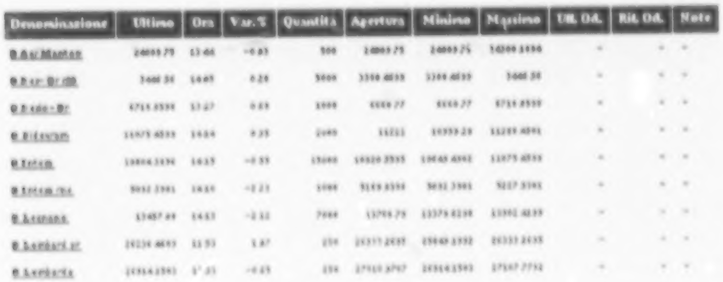
```
000 0001
000 0002
```

3. Automatic wrapper generation

The Web-OEM query language provides for a tool for automatic generation of customized wrappers. Indeed, a Web-OEM query represents a high-level specification of the wrapper and a Web-OEM query executor can be seen as an actual wrapper generator.

In order to generate customized wrappers, the user must provide the system with an explicit representation of the data base schema and the information sources. It is worth noticing that the models of the data base schema and of the information sources are included in the Web-OEM-QL query. Indeed the FROM and the WHERE clauses define a model of the information source, while the SELECT clause denotes (a portion of) the data base schema.

Specifically, the information extraction process with Web-OEM is performed by the following steps:



Denominazione	Ultimo	Ora	Var.%	Quantità	Apertura	Minimo	Massimo	Ult. Od.	Rit. Od.	Note

Figure 1: A Web page with the Italian stock market data

1. The user analyzes the information source (a set of Web pages) and individuates the structures containing the relevant data to be extracted.
2. Considering the data base schema and the source structure, the user writes a Web-OEM-QL query.
3. The system processes the query in two steps: (i) Web pages are automatically parsed and a Web-OEM description is generated; (ii) data are extracted form the description of the pages according to the specification of the query.

This framework can be useful in several applications. One example is monitoring stock market data, that are daily published by many specialized Web sites. Observe that these data are presented in several different ways by the Web sites. Moreover, within a single source, the Web pages usually change their contents over time, but not their structure.

This task can be performed by generating customized wrappers that are in charge of extracting relevant data from the given Web sites. Specifically, the user analyzes the HTML structure of the relevant pages and, by knowing the data base schema, s/he writes a query expressing which data are to be extracted and how this must be done. A "compilation" of this query corresponds to the generation of a customized wrapper and its execution allows for actual extraction of specified data. Assuming that sources do not change their structure over time, it is possible to daily run such a wrapper in order to monitor a specified set of shares.

In [Fig. 1] a portion of a Web page containing data from the Italian stock market is shown. The following query allows for extracting the company name (first column) and its current price (second column).

```
SELECT x1.text, x2.text
FROM Page:p, Table:t, TableRow:r, Text:x1, Text:x2
WHERE p.url="http:\\x.y.z\a.html" AND t IN p.structures.* AND
    t.nrows > 20 AND r IN t.rows AND
    x1 = r.elements[0] AND x2 = r.elements[1]
```

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The query returns the following data:

B Agr Mantov 24009.75
B Des-Br r99 3446.56
...

Observe that this approach to information extraction from the Web requires the user to explicitly define a model for each information source. Indeed, while writing a query, the user must know where the relevant data are in the Web pages. Therefore a problem to be addressed is the integration of data coming from different information sources. Suppose, for example, that a user wants to monitor shares from different stock markets and that relevant information are published by different sources. The user must write many queries and the results of these queries must be appropriately integrated. In some cases it is possible to adapt the data base schema to the information sources, such that integration is solved by the user when writing the queries. However, in other cases, a more general method (a mediator [Papakonstantinou et al. 1996]) is required for an effective integration of data.

Nevertheless, the Web-OEM approach to generation of customized wrappers has several advantages. To summarize: (i) it allows for quick implementation of simple information extraction tasks, (ii) it is suitable for information sources that dynamically change their data, but not their structure, (iii) it allows integration of data coming from different sources by an appropriate writing of queries.

4. Conclusion

An effective information management within an organization deeply depends on tools for accessing and summarizing relevant data from the information sources. Web information extraction systems thus represent important tools for retrieving interesting data from the enormous amount of information contained in the World Wide Web.

In this paper we have presented a simple data model for representing Web pages and a method for automatic generation of customized wrappers for information extraction from the Web. We believe that the Web-OEM model represents an effective and well-formalized tool for Web information extraction and that this is an important step towards the development of automatic information extraction systems. Moreover, the method is simple to implement and effective in many cases, and it provides for the scalability that is required by such systems.

This research is a first step towards the development of Web *wrapper agents*, that is software agents able to navigate in the Web sites and to extract relevant information. Such an agent should make use of a Web-OEM representation of the Web pages and of the Web-OEM-QL language for automatic generation of queries for data extraction and for their execution in order to populate the data base.

5. References

Abiteboul, S. & Quass, J. & McHugh, D & Widom,J. & Wiener,J. (1997). The Lorel query language for semistructured data. *International Journal on Digital Libraries*, 1(1).

Christophides, V. & Cluet, S. & Moerkotte,G. (1996). Evaluating queries with generalized path expression. *Proceedings of ACM SIGMOD Symposium on the Management of Data.*

De Rosa, M. & Iocchi, L. & Nardi, D. (1998). Knowledge representation techniques for information extraction on the Web. *Proceedings of WebNet'98.*

Florescu, D. & Levy, A. & Mendelzon, A. (1998). Database techniques for the World Wide Web: a survey. *SIGMOD Record*, September 1998..

Hammer, J. & Garcia-Molina, H. & Nestorov, S. & Yerneni, R. & Breunig, M. & Vassalos, V. (1997) Template-based wrappers in the TSIMMIS system. *Proceedings of 1997 ACM International Conference on Management of Data (SIGMOD'97).*

Iocchi, L. & Nardi, D. (1997). Information access in the Web. *Proceedings of WebNet'97.*

Kistler, T. & Marais, H. (1997). WebL a programming language for the Web. *Technical Report 1997-029, Digital Systems Research Center, December 1997.*

Lacroix, Z. & Sahuguet, A. & Chandrasekar, R. (1998). Information extraction and database techniques: a user-oriented approach to querying the Web. *Proceedings of 10th Conference on Advanced Information Systems Engineering (CAISE'98).*

Mendelzon, A. & Mihaila, G. A. & Milo, T. (1997). Querying the World Wide Web. *International Journal on Digital Libraries, 1(1).*

MUC (1998). Message Understanding Conferences. http://www.muc.saic.com/.

Papakonstantinou, Y. & Garcia-Molina, H. & Widom, J. (1995) Object exchange across heterogeneous information sources. *Proceedings of 11th International Conference on Data Engineering.*

Papakonstantinou, Y. & Gupta, A. & Garcia-Molina, H. & Ullman, J. (1995) A query translation scheme for rapid implementation of wrappers. *International Conference on Deductive and Object-Oriented Databases.*

Papakonstantinou, Y. & Abiteboul, S. & Garcia-Molina, H. (1996). Object fusion in mediator systems. *Proceedings of 22nd International Conference on Very Large Databases (VLDB'96).*

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Adaptive Changes Monitoring Service in Web Repositories Based on Agent Games

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Abstract: Changes made in Web repositories occur at unpredictable rates. Besides the target information itself, the changes upon the previously released information are significant and worth being notified to those who perceived the out of date information as soon as possible. Unfortunately, stock type information source has no means to inform its prospective users about the changes. While the stock type information source occupies a large percentage of sources on the Web, it is necessary to have a system that monitors changes on the Web, and provides comprehensive presentation to the prospective users. This paper proposes a mechanism that incorporates change monitoring and presentation service for a user community. The service keeps improving its utilization factor by several schemes based on the decision made by game analysis. Thus, the service can be provided to a relatively large group of users.

1. Introduction

The information in Web repositories is changed dynamically without any prior notification. At present, a large number of information sources are stock type. The users access this type of information in pull mode, mostly by Web Browsers. These information sources have no mechanism to bring the changed information to prospective users. The users have to deal with the matter by themselves. Browsing through the sites for new updates is not only time consuming task but also vain in case that there is no change made on the sites once visited. This puts a significant load to the users besides exploring brand new information.

This paper considers the evolution of mechanism that detects and evaluates changes on the Web, as well as provides it in comprehensive form for prospective users. With this system, The ubiquitous stock type information sources on the Web have no need to provide any effort to convey their updates to the users. As a result, the information is seemingly transferred in push mode.

We incorporate shared resource management in our system in order to enable a larger scale of service. The shared resource management plays an important role to make the push mode transfer of changes and differences practical. The system would not be practical if the available resources are used to provide service to a large group of users without an effective resource management processing. The service attempts to increase the utilization factor of the system by several schemes. Each scheme tries to increase identical services in the monitoring process. These identical or virtually identical requests give a significant impact on the utilization of our service. As long as we can implement the service with reasonable resource allocation, more users can have access to our service. At this point, we let the service interacts with user. However, the interaction must be made minimal in order to maintain the level of automatism of the service.

We consider the schemes that deal with user as games. The games are played by users and the service agent. The service agent decides its moves based on experience in the past and game analysis. A useful tool we use here is the game theory. We apply the tool from the viewpoint of our service. Overall, the service agent improves the utilization factor of the service and gets the most out of limited interaction with the users.

2. Architecture of the service

The monitoring service consists of the service provider and user interface. The service is designed so that the service can be accessed from the Internet. Each user accesses the service via the WWW using any browser with

Java Virtual Machine. Requests can be made directly to the service provider. The service provider consists of several modules as follows:

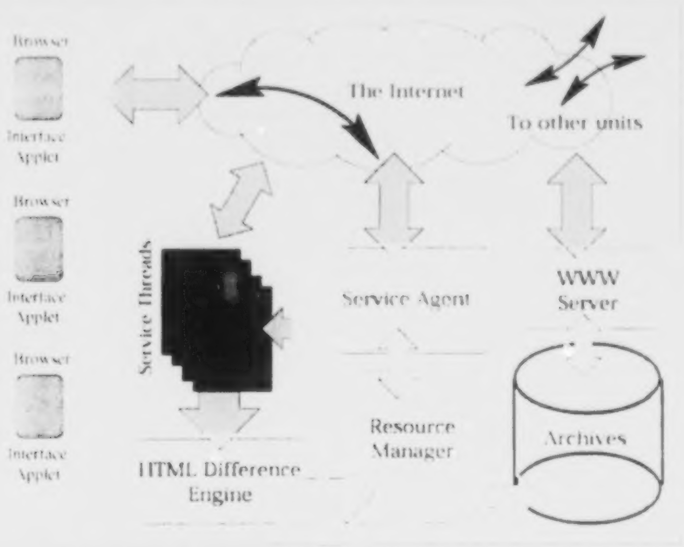

Fig. 1 The architecture of change monitoring service.

- **Resource Manager**: This module handles all resources for the service. Resource Manager will keep the results from the HTML Difference Engine in the archives. It keeps improving the utilization factor of the system by matching all identical or virtually identical requests.
- **Service Threads**: Each Web page monitoring request will be handled by a service thread. The thread keep monitoring and comparing revisions of that Web page.
- **Service Agent**: This is the heart of the service that interacts with other modules in order to retrieve and compare Web pages. It takes requests from the users and consults the Resource Manager to allocate resource for incoming requests. It activates the service threads to start services. When the users query their service profiles, it works as a service broker that retrieves the profiles for the users. The users can edit their service profiles via the Service Agent. Moreover, the Service Agent handles all responses made by users when the service needs to know opinions of the users. The responses from the users are proceeded to the Resource Manager in order to decide how to improve the service.
- **HTML Difference Engine**: The service threads implement the Difference Engine in order to compare the content of updated pages and see whether there are significant changes in them. Running the Difference Engine compares the old and new versions of HTML documents. At the same time, it will summarize the updated information into another HTML document by an innovative algorithm described "Difference and Display" subsection.
- **WWW server**: The page archives contain the old and new version of Web pages together with summary pages constructed by the HTML Difference Engine. When the users are notified by their Service Agent, they can view the summary pages with their browsers via the WWW server.

3. Monitoring the changes

The monitoring service keep monitoring the changes in Web repositories and making comprehensive presentation of the changes available to the users. Once the Service Agent found significant changes, it notifies the users. The consideration for each task is described in detail in following topics:

3.1. Difference and Display

Our HTML Difference Engine implement the algorithm called "Longest Common Tag Sequence"

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(LOCTAGS) which is developed from the basic idea of Longest Common Subsequence (LCS) algorithm. The well known LCS has been widely used in comparison of text document revisions for long. When comparing 2 revisions of text with the capability of common subsequence extraction, we can tell the actions made on the new document easily. Unfortunately, the traditional LCS is not applicable to hypertext document. In order to cope with the structured text like HTML, we regard the HTML document as a sequence of tags and context. We use LOCTAGS to find the common subsequence of the new and old version of tag streams. Once we have the common subsequence of tags, we can point exactly which tags were deleted or added. This information helps us in comparing the context pairs at the right place. In other words, the LOCTAGS provides information about which context in the older revision should be compare to which context in the new revision.

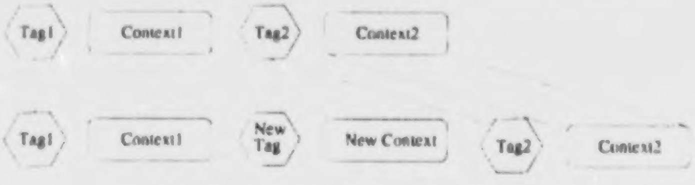

Fig. 2 The streams of HTML document.

When comparing context, we apply the traditional LCS. Difference Engine. The tool takes both the old and new HTML documents as its inputs. Both tags stream are fed to the LOCTAGS detector. The result, common tag subsequence, is used as a reference information at the differentiator. Right here, one of the output lines is fed to the HTML Constructor in order to produce a summary page in HTML format. On the other hand, the output is fed to the filtering process that evaluates the changes based on user interests. The result of evaluation is used by the decision-maker. The decision-maker decides whether the changes should be pushed to the users.

3.2. Push it to the users

Once the changes are detected, the difference engine evaluates the content of the changes. The evaluation is necessary because it is no use to push a piece of insignificant information of changes to the user. The evaluation is taken place in the filter based on user interests. If the changes are considered significant, the service provider sends notification to the user and let the user select to show the difference. The criteria used in this process focus on the filtering process, which is based on user interest as described in next topic.

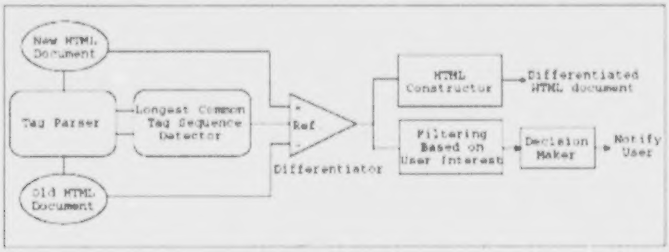

Fig. 3 The HTML Difference Engine with the Decision Maker

3.3. User Interests

We divide the interests of the users into following categories:

- Existence of contents: Many users are curious to know whether the contents they interested in are still exist in or newly added to the document. It is inevitable to check the existence of components again once the document was reviewed. The filter used in our service provider agent deals with this demand by checking the existence of links, images, Java applets, etc. that appear in the new version of document. The filter provides a report of the change in existence of component by comparing with the old version. The service provider agent notifies the user via email with this information in order to tell the user roughly how much the document has been changed.
- Appearance of document: HTML specification includes many tags that control the flow and structure of HTML documents. In some cases, many users are curious about the change in the appearance of the

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documents. We take the appearance changes into account when evaluating the changes.

- Topics in interest: This category is the most important issue when we deal with the user's interests. In real world, people evaluate whether the content they are reading fall in the area of their interest by the context. If we insist to deal with this issue rigorously, we have an expensive processing to pay. The evaluation of relevance to user's interest areas is considered to be heuristic. On the other hand, the process needs natural language processing techniques. We compromised the correctness with computational costs. The filter deals with this issue by the key words that relevant to the interests of the user.
- Scoring of changes: When the filter found any changes that fall into the first two categories, it evaluates a score of those changes. The score of each category is a fix value assigned accordingly to the importance of the category. However, the third category deals with key words. We assume that the more occurrences of the key word in the document, the closer to the user's interest the document is. The score of each key word is increased as the more occurrences of the key word are detected. Finally, the total score is the summation of all categories of changes. The score is then compared to the specified threshold. It the score is higher than the threshold, the Service Agent notifies the user about the changes.

4. Adaptive Resource Management

When serving a large number of users, we expect to have some identical or virtually identical requests. These requests can share the resource. The more identical or virtually identical requests, the better utilization factor we can get from the service. The Resource Manager deals dynamically with the request matching. The conditions of virtually identical requests change dynamically upon the changes in Web repositories and the parameters of the request made by the users. If we decide to push changes and difference information, we attempt to push the information to prospective users. The fact is that each user has different degree of interest and attitude against the detected changes. In the paper, we define the utilization factor of the service as follows:

Utilization factor:

$$U = \frac{N - M}{M}$$

Where:

N = the number of all request

M = the number of different kinds of requests. M is also defined in term of probability of having different kinds of request (P_{diff}).

$$U = \frac{N - P_{diff} N}{P_{diff} N} = \frac{1 - P_{diff}}{P_{diff}}$$

We can see obviously that if we share resource among users, we are likely to get more profit than serving each user separately. The utilization factor, finally, depends on the Pdiff, which ranges from 1/N to 1. The range tells us that our utilization factor ranges from 0 to N-1.

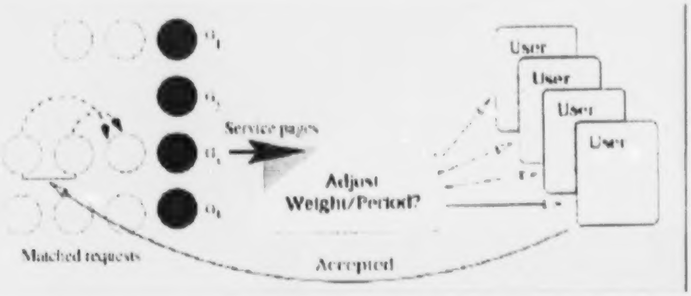

Fig. 4 The Service Agent requests the users to adjust the parameters of services

The amount of identical or virtually identical requests can vary dynamically. This is the case when some

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requests among currently identical requests are satisfied by the changed conditions but some are not. For examples, we decide to push changes information to the usér if we found that the change score is higher than specific threshold points. Suppose we have 2 users who specified the score threshold for identical page at 1500 and 1000 points. Both requests are considered identical if the change score is 2000 points. However, if the change score fall between 1000 and 1500 points, the requests are no longer identical. The Resource Manager analyzes the characteristic of changes on Web pages. A parameter to check is the notification threshold. In some cases, some users specified high thresholds with high frequency of monitoring. If the Resource Manager found that the change rates of those pages are relatively slow, it may ask the users to adjust threshold weight of notification or monitoring frequency.

Adjusting these parameters has probability to increase more matched requests. Meanwhile, the Resource Manager detects hot requests shared by a large number of users. The hot requests trend to be interesting pages. The Resource Manager may recommend these requests to the users. If some users accept the recommendation, the utility factor of the service trends to be increased according to the increasing matched requests.

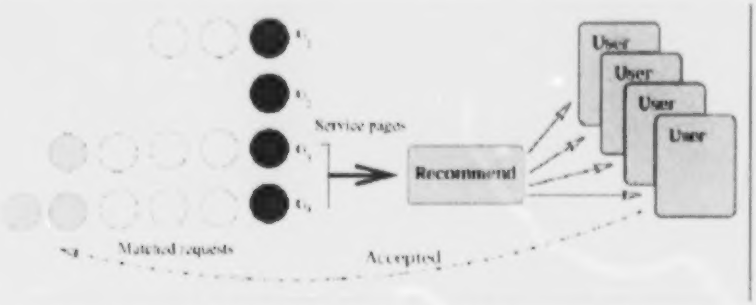

Fig. 5 The Service Agent recommends some hot pages to the users.

However, the Resource Manager has to make decision based on facts and experience in the past whether it should ask the users to adjust some parameters or recommend some hot requests to the users. The Resource Manager makes a decision by investigating the probability of improvement from the pay-off matrix of the game. We will consider how to make decision based on our service games from the following expected pay-off matrix.

		User	
		No Adjustment	Adjust
Service Agent	No Adjustment	p_0	p_1
	Adjust	p_2	p_3

Improvement occurs when:

1. The user obeys the suggestion from the agent, we apply the p_0 and p_3.
2. When user adjusts while agent does not suggest, we apply p_1
3. The agent suggests but the user does not adjust, we apply p_2

With these policies in mind, we can implement the random equilibrium criteria and derive the probability of improvement. (If P_a is the probability that the agent suggests an adjustment, and P_u is the probability that the user adjusts the service profile)

$$P(improve) = (P_a P_u) p_3 + (1 - P_a)(1 - P_u) p_0 + P_u(1 - P_a) p_1 + P_a(1 - P_u) p_2$$

But P(improve|P_a=0) = P(improve|P_a=1) and P(improve|P_u=0) = P(improve|P_u=1)
Solve for P_a, P_u then substitute into P(improve) we derive

$$P(improve) = \frac{(p_1 p_2 - p_0 p_3)}{(p_1 + p_2 - p_0 - p_3)}$$

The service agent checks whether the P(improve) is above 0.5 which means the system has probability to improve the service more than 0.5, if it asks the user for adjustment. In our service, the probability p_3 can be derived by a function that evaluates how significant a request for adjustment is. The probability p_2 comes from the experience in the past, which is, in other words, how much the user refuses the suggestion. The probability p_1 comes from the improvement made when the user adjusts the service profile without suggestion from the Service Agent. Finally, the probability p_0 comes from the self-improvement rate occurred as the conditions of changes in Web repositories vary in time domain. We can see obviously that the variables used in the game analysis above can be evaluated at ease from the statistic of the service. The Service Agent can make decision to deal or not to deal with the user by calculating the P(improve) based on transactions in the past. Moreover, each decision trends to be more exact as the experience of the Service Agent increases.

5. Related Work

From the standpoint of tracking and viewing changes on the Web, the work that is most similar to ours is that of Douglis, et al. [Douglis 98], [Douglis 96]. They used the AT&T Internet Difference Engine to compare revisions of Web pages of some enterprises from time to time. Their work inspires a great deal in our work. We attempt to improve the service for a larger scale of users. We manage the shared resources among users in order to enable induced push mode of changes and differences. Besides, our difference engine implements the LOCTAGS algorithm, which is capable of comparing context exactly where the revisions should be compared. In addition to a target page, we assume that the child pages are likely to have relevant information. Therefore, the service provider agent can be requested to watch the target down to its child pages. If needed, the agent can also be requested to watch deep down to the grandchild pages. However, the grandchild level is limited to the pages in the same domain of each child page.

The Do-I-Care agent [Starr 96] applies social discovery and filtering to inform the users when changes are detected. Moreover, it takes advantage of training the agent by groups of users where some interesting information may be offered to the user via the effort of others. We agree with the idea but we need a simpler way for evaluation of changes. The scoring method we use is straightforward and can be carried out quickly while providing a way for users to adjust the threshold value upon their experiences. In our system, the social filtering effect occurs when the Resource Manager cooperates with the Service Agent in order to improve the utilization factor.

6. Summary

In this paper, we presented the evolution of the mechanism that notifies the users about changes in Web repositories, as well as preparing the summary of the changes. The shared resource management based on game analysis and experience in the past helps us in providing information pushing service to a large group of user. The effort to improve the utilization factor of the service brings about an adaptive monitoring service. The evaluation of the functions we used to evaluate the probability in the expected pay-off matrix of service games gives a significant impact on the accuracy of making a decision. These details should be considered in future studies.

7. References

[Douglis 98] Fred Douglis, Thomas Ball, Yih-Farn Chen and Eleftherios Koutsofios (1998). The AT&T Internet Difference Engine: Tracking and viewing changes on the web, World Wide Web, 1998 1(1), 27-44.

[Aglet 97] Aglet-Workbench - Programming Mobile Agents in Java, IBM Tokyo Research Lab., URL: http://www.trl.ibm.co.jp/aglets/.

[Bradshaw 97] Jeffrey M. Bradshaw (1997). *Software Agents*. AAAI Press/The MIT Press.

[Douglis 96] F. Douglis, T. Ball, Y. Chen, E. Koutsofios (1996). Webguide: Querying and Navigating Changes in Web Repositories, In Proceedings of the *Fifth International World Wide Web Conference*, Paris, France, May 1996, 1335-1344.

[Starr 96] Brian Starr, Mark S. Ackerman, Michael Pazzani (1996). Do-I-Care: A Collaborative Web Agent Proceeding of *ACM CHI'96*, April.

The Use of Relevance Feedback on the Web: Implications for Web IR System Design

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Abstract: We conducted a transaction log analysis of 51,473 queries from 18,113 users of Excite, a major Web search engine. Approximately 2,500 (approximately 5%) of these queries were from the use of relevance feedback. Given the high level of research activity and historical success of relevance feedback in assisting users in locating relevant information, this is a surprising small percentage of usage. In order to investigate this phenomenon on the Web, we analyzed users sessions that contained relevance feedback queries. We identified states and patterns in these sessions. We also attempt to classify the sessions as successfully or not. This analysis provides insight on the current use of relevance feedback on the Web, its success or failure, and why it is so seldom utilized. We relate our conclusions to system design of information retrieval systems on the Web.

Introduction

Transaction log analysis is a proven analytical technique in information science that can provide excellent data on user searching characteristics (Peters, 1993). In order to gain insight into Web users and their use of advanced searching techniques, we conducted a transaction log analysis of 51,473 queries from 18,113 users of Excite, a major Web search engine. The analysis focused on two levels of investigation, the session level and the query level.

From our analysis, we were able to identify the queries that were a result of a relevance feedback option and isolate the sessions (i.e., sequence of queries by a user over time) that contained relevance feedback queries. Of the over 50,000 queries only about 5% were from Excite's relevance feedback option. This is a surprisingly small percentage of the queries compared to traditional information retrieval (IR) system usage.

Relevance feedback is a classic information retrieval (IR) technique that reformulates a query based on documents identified by the user as relevant (Salton, 1983). Relevance feedback has been and still is a major and active IR research area. Relevance feedback is widely used and reported to be extremely successful in many traditional information retrieval systems. However, why is it not widely used on Web search engines? Is it too difficult for users?

When using the Excite search engine (http://www.excite.com), if one finds a documents that is relevant, the user need only "click" on a hyperlink that implements the relevant feedback option. It does not appear to be any more difficult than normal Web navigation. In fact, one could say that the implementation of relevance feedback is one of the simplest IR techniques available. There are more complicated IR techniques that are used more frequently, such as Boolean operators and term weighting. We found it surprising that this highly touted and widely researched IR feature implemented in straight forward fashion was so seldom utilized.

We analyzed the sessions that contained the approximately 2,500 relevance feedback queries to isolate the user characteristics. We identified patterns in these sessions. These patterns are composed of states and transitions from and to the same or other states. From these characteristics, we hope to gain insight into the possible causes of this the low use of relevance feedback and, possibly, methods to increase its use among Web users. These methods could be applied to design of IR systems on the Web. This paper extends finding finds from (Jansen, Spink, Bateman, & Saracevic, 1998).

Review of Literature

Relevance feedback is a well-known IR technique (Salton, 1983) to improve the performance of IR systems. It has been widely researched (Salton & Buckley, 1990), (Harman, 1992), (Koenemann, 1996), and (Dunlop,1997). It has been reported to successful improve retrieval performance for at least a small number of iterations (Witten, Moffat, Bell, 1994). Although previous studies have focused on a variety of IR systems, we could locate no study that analyzed the use of relevance feedback on a major Web search engine such as Excite.

Background on Excite

Founded in 1994, Excite, Inc. is a major Internet media public company which offers free Web searching and a variety of other services. The company and its services are described at its Web site, thus not repeated here. The search capabilities of Excite are briefly summarized.

Excite searches are based on the exact terms that a user enters in the query, however, capitalization is disregarded, with the exception of logical commands AND, OR, and AND NOT. Stemming is not available. An online thesaurus and concept linking method called Intelligent Concept Extraction (ICE) is used, to find related terms in addition to terms entered. Search results are provided in a ranked relevance order. A number of advanced search features are available. A page of search results contains ten answers at a time ranked as to relevance. For each site provided is the title, URL (Web site address), and a summary of its contents. Results can also be displayed by site and titles only. A user can click on the title to go to the Web site. A user can also click for the next page of ten answers. There is a clickable option *More Like This*, which is a relevance feedback mechanism to find similar sites. When *More Like This* is clicked, *Excite* enters and counts this as a query with zero terms.

Each transaction record contained three fields. With these three fields, we were able to locate a user's initial query and recreate the chronological series of actions by each user in a session:

1. **Time of Day**: measured in hours, minutes, and seconds from midnight of 9 March 1997.
2. **User Identification**: an anonymous user code assigned by the *Excite* server.
3. **Query Terms**: exactly as entered by the given user.

Focusing on our two levels of analysis, sessions and queries, we defined our variables in the following way.

1. **Session**: A session is the entire series of queries by a user over time. A session could be as short as one query or contain many queries.
2. **Query**: A query consists of one or more search terms, and possibly includes logical operators and modifiers.

Overall Statistics

Given the way that the transaction log recorded user actions, relevance feedback option was recorded as a empty query. However, a user entering a empty query would also be recorded the same. Using a purely quantitative analysis, we isolated 2,543 null queries, which represents the maximum number of relevance feedback queries. For this study, we had to remove the relevance feedback queries from the mistakes. Therefore, we reviewed the data and removed all queries that were obviously not the result of relevance feedback. If a determination could not be made, the query remained in the study. The results are summarized in Table 1.

Classification	Number of Queries	Percentage
Relevance Feedback	1597	63%
Mistakes	946	37%
Total	2543	100%

Table 1: Percentage of Relevance Feedback Queries.

As one can see, fully 37% of the possible null queries were judged not to be relevance feedback queries but instead some sort of mistake. This result in itself is very interesting and noteworthy for Web IR system designers. The high level of failures implies that something with the interface or the system is causing users to enter null queries just under 40% of the time. From observational evidence, some novice users "click" on the search button thinking that it takes them to the screen for searching. Additionally, Peters (1993) states that users many times enter null queries. Regardless of the reason for the mistakes, the maximum possible relevance feedback queries was 1,597. These queries resulted from 823 user sessions, implying an average of 1.99 relevance feedback queries per user session.

We then wanted to isolate patterns, if any, in the user sessions. Working with the 823 user sessions, we classified each query in the session as belonging to one of the following states:

- **Initial Query** was the first string of terms that a user entered for a session.
- **Modified Query** was the second or subsequent entry (i.e., query) that was related to the query before it. Related being defined as processing one or more of the same terms or obviously related to the same topic as the preceding query.
- **Next Page** was a request by the user to view the next page of 10 results.

- **New Query** was a second or subsequent entry by a user that was unrelated to the previous query.
- **Relevance Feedback** was the utilization by the user of the relevance feedback option, "More Like This."
- **Previous Query** was the second or subsequent entry by a user that was exactly like the previous entry.

We first analyzed the number of occurrences of each state.

State Analysis

The number of occurrences of each state is listed in Table 2. There were 2148 unique states in the 804 user sessions. As to be expected, relevance feedback occurred by far (872). Ignoring initial query, the next most common state was next page (542). This indicates that that there was a number of viewing of subsequent results by users. There were also a large number of modified queries, indicating the addition, removal, or change of query terms.

State	Number of Occurrences
Relevance Feedback	872
Initial Query	804
Next Page	542
Modified Query	467
Previous Query	151
New Query	116
Total	2952

Table 2: Occurrences of Non-Repeating States.

We then examined where each state occurred in the session. The shortest session was two queries. The longest session was seventeen queries. These results are displayed in Table 3.

Type	Query 1	Query 2	Query 3	Query 4	Query 5	Query 6	Query 7	Query 8	Query 9	Total
Initial Query	804	0	0	0	0	0	0	0	0	804
Relevance Feedback	0	371	284	93	63	26	15	8	7	867
Next Page	0	282	63	66	56	26	19	14	5	531
Modified Query	0	132	133	82	38	35	21	12	6	459
New Query	0	19	31	25	14	14	4	3	4	114
Previous Query	0	0	54	48	23	11	8	4	1	149
Total	804	804	565	314	194	112	67	41	23	2924
Type	**Query 10**	**Query 11**	**Query 12**	**Query 13**	**Query 14**	**Query 15**	**Query 16**	**Query 17**		**Total**
Initial Query	0	0	0	0	0	0	0	0		0
Relevance Feedback	2	2	1	0	0	0	0	0		5
Next Page	3	3	0	3	0	1	0	1		11
Modified Query	3	1	3	0	0	0	1	0		8
New Query	2	0	0	0	0	0	0	0		2
Previous Query	1	0	0	0	1	0	0	0		2
Total	11	6	4	3	1	1	1	1		28

Table 3: Frequency of State Occurrence at each Session Level.

Given that there were no one query session in this sample (i.e., the shortest session was Query -> Relevance Feedback, a two query session), we see from Table 3, that there were 239 two query sessions, the largest group. However, there were 251 three query session, 120 four query session, 82 five query sessions, followed by a fair number of six and seven query sessions.

We see that the distribution of state occurrences shift as the length of the session increase. For the sessions of two and three queries, the relevance feedback state is the dominant state. As the length of the queries increase, the occurrences of relevance feedback as a percentage of all states decrease. Beginning with session of five queries or more, relevance is no longer the state with the most occurrences. This would seem to indicate that relevance feedback was not successful for these users, and they resorted to other means to find relevant information. This is evidence by the predominance of the modified query state in these lengthier sessions.

State – Transition Analysis

Based on this analysis, we could examine the transitions between states in each session. We isolated four patterns that classified all relevance feedback session. These patterns are displayed in Figure 1. Noted that we account for the returning to the same state. With the identification of these four states, it is clear that the IR system interface should be tailored to support these patterns of occurrence, namely in the transitions from one state to a different state.

Session Analysis

Given the low occurrences of relevance feedback queries, we attempted to determine if the session containing relevance feedback was successful or not. Without access to the users, this was difficult and required some assumptions. If the user utilized relevance feedback and quit, we gave relevance feedback the benefit of the doubt and counted it as a success (i.e., the user found something of relevance). Probably, many times these were not successfully, so our count of relevance feedback successes if probably on the high side.

If the user utilized relevance feedback and returned to the exact previous query, it is safe to assume that nothing of value was found. There were some sessions where the user used relevance feedback and returned to a similar but not exact query.

Since once could say that the relevance feedback query could have provide some terms suggestions, we classified these session as less than successful.

Some sessions, could also be classified as browsing, namely the user uses relevance feedback and then returns to the session with a totally new query.

The results are summarized in Table 4.

Classification	Number of Occurrences	Percentage
Success	509	63%
Failure	126	16%
Less Than Successful	135	17%
Browsing	34	4%
Total	804	100%

Table 4: Classification of Relevance Feedback Sessions.

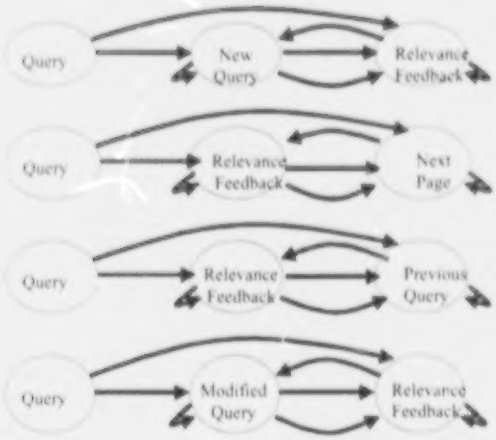

Figure 1: The State - Transition Diagrams of Relevance Feedback Sessions.

As one can see in Table 4, giving relevance feedback the benefit of the doubt, fully 63% of the relevance session could be construed as being successful. If the less than successful are included, then almost 80% of the relevance feedback session provide some measure of success.

The question then becomes, why is relevance feedback used more on the Web search engine? In order to hopefully gain insight to this, we wanted to see if the population that used relevance feedback different from the population at large.

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Comparison to Population at Large

We first examined the query construction of relevance feedback users to the query construction of the general population. This is shown in Table 5. The total percentage for each percentage column does not sum to 100% because the relevance feedback queries are not included. There appears to be little different between the relevance feedback users and the population in general. Assuming that lengthier queries are a sign of a more sophisticated user, it appears that the relevance feedback population does not difference significantly from the general population of Web users.

Terms Per Query	Number in Relevance Feedback Population	Percent of Relevance Feedback Queries	Percent in General Population
1	972	19.80%	31
2	1045	21.29%	31
3	635	12.94%	18
4	310	6.32%	7
5	195	3.97%	4
6	70	1.43%	1
7	36	0.73%	0.94
8	23	0.47%	0.44
9	3	0.06%	0.24
> 10	22	0.45%	0.36
Total	4908	67.46%%	93.98

Table 5: Terms Per Query.

Next, we examined the number of queries per user. This data is displayed in Table 6. In queries per user, the relevance feedback population had significantly longer queries than the population at large. The median number of queries per user for the relevance feedback population was approximately 2 and for the general population it was 1. There were also a significant number of relevance feedback users that had session of 3, 4, 5, and even 6 queries. In the general population, there is a steep drop-off at 2 queries per user. This may indicate that relevance feedback were more persistent in satisfying their information need and therefore more willing to invest the time to use not only relevance feedback but more larger sessions in general.

Query Per User	Number of Users	Percentage of RF Users	Percentage of General Population
1	3	0.36%	67.00
2	375	45.29%	19.00
3	223	26.93%	7.00
4	97	11.71%	3.00
5	64	7.73%	1.60
6	34	4.11%	0.80
7	11	1.33%	0.44
8	4	0.48%	0.18
9	8	0.97%	0.20
10	6	0.72%	0.09
11	1	0.12%	0.04
> 12	1	0.12%	0.04
		99.87%	99.39

Summary

We conducted a transaction log analysis of 51,473 queries from 18,113 users of Excite, a major Web search engine. Of the over 50,000 queries only about 5% were from Excite's relevance feedback option. This is an extremely small percentage of the queries. In order to gain insight into the possible causes of this phenomena, we analyzed the sessions that contained the approximately 2,500 relevance feedback queries.

Given the way that the transaction log recorded user actions, relevance feedback option was recorded as a empty query. Fully 37% of the possible relevance feedback queries were judged not to be relevance feedback queries but instead some sort of mistake

We isolated states within each session, identifying 6 possible states, query, relevance feedback, modified query, previous query, next page, and new query. Of these state, relevance feedback was the most common, occurring 872 times.

We then examined the occurrence of each state at each query in the session. The shortest session was two queries. We sew that the distribution of state occurrences shifts as the length of the session increase. For the sessions of two and three queries, the relevance feedback state is the dominant state. As the length of the queries increase, the occurrences of relevance feedback as a percentage of all states decrease.

Based on this analysis, we isolated four patterns that classified all relevance feedback session. These patterns are displayed in Figure 1. Noted that we account for the returning to the same state.

Given the low occurrences of relevance feedback queries, we attempted to determine if the session containing relevance feedback was successful or not. As one can see, given relevance feedback the benefit of the doubt, fully 63% of the relevance session could be construed as being successful. If the less than successful are included, then almost 80% of the relevance feedback session provide some measure of success.

We then compared the relevance population to the population at large. We first examined the query construction of relevance feedback users to the query construction of the general population There appears to be little different between the relevance feedback users and the population in general.

Next we examined the number of queries per user. The relevance feedback population had significantly longer queries than the population at large. The median number of queries per user for the relevance feedback population was about 2 and for the general population it was approximately1.

Conclusion

The data and analysis suggest that relevance feedback is successful for Web users, although only a small percentage of Web users take advantage of this feature. On the other hand, although it is successful over 60% of the time, this implies a 40% failure rate or at least a not totally successful rate of 40%. This may be one reason relevance feedback is so seldom utilized. Its success rate on the Web is just too low.

As for user characteristics of the relevance feedback population, they do not appear to differ in terms of sophistication from the other Web users, but they exhibit more doggedness in attempting to locate relevance information. This could be for several reasons. One may suspect that the subjects they are searching for are more intellectually demanding. A cursory analysis of the query subject matter and terms does not support this conclusion.

There does appear to be four distinct sessions patterns of relevance feedback users on the Web. If these can be generalize to other Web search engines other than Excite, remains to be seen. However, at the very least it points to the need to tailor the interface to support these patterns if the goal is to increase the use of relevance feedback. Another option may be to automate the search engine to retrieve relevant documents of any result the user examinees. This approach would be similar to research by Lieberman (1998). The results could then be presented to the user without the user initiating the process.

References

Dunlop, M. (1997). The effect of accessing nonmatching documents on relevance feedback. ACM Transaction on Information Systems, 15(2), 137 – 153.

Harman, D. (1992). Relevance feedback revisited. Paper presented at *14th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, Chicago, IL.

Jansen, B., Spink, A., Bateman, J. & Saracevic, T. (1998) Real life information retrieval: A study of user queries on the Web. *SIGIR Forum, 32*(1), 5-17.

Koenemann, J. (1996). Supporting interactive information retrieval through relevance feedback. *Proceedings of the CHI'96 Conference*, 49-50.

Lieberman, H. (1998). Integrating user interface agents with conventional applications. Paper presented at *International Conference on Intelligent User Interfaces*, San Francisco, CA.

Peters, T. (1993). The history and development of transaction log analysis. *Library Hi Tech, 42*(11), 41-66.

Salton, G. (1983). *Introduction to Modern Information Retrieval.* New York: McGraw-Hill.

Salton, G. & Buckley, C. (1990). Improving retrieval performance by relevance feedback. *Journal of the American Society for Information Science. 41*(4), 288-297.

Witten, I., Moffat, A., & Bell, T. (1994). *Managing Gigabytes: Compressing and Indexing Documents and Images*. New York: Van Nostrand Reinhold.

Film Theory Meets 3D Internet
A Film Semiotic Approach to the Design and Analysis of 3D Virtual Worlds on the Web

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Abstract: The purpose of this paper is to discuss possible approaches through which 3D spaces – and especially 3D Internet – can be studied from a semiotic, or more specifically a film semiotic, point of view. First similarities and differences between 3D spaces – seen as a new form of multimedia – and the film medium are discussed. Then basic concepts from film semiotics are introduced. Finally, features of 3D Internet are described and discussed on the basis of key concepts from film theory such as: mise-en-scène, montage, and the relation of sound to image.

A virtual 3D space is characterized by being generated from software and drawn as interactive 3D computer graphics, in this context understood as a way of representing 3D data in 2D so that it can be viewed on a screen. When this space is joined to other computers linked on the Internet, we have 3D Internet. Thus, 3D spaces and 3D Internet exist only in the digital domain of the computers and the computer networks. It is these 3D spaces and 3D virtual worlds (3DVWs) on the Internet that are the primary object of this study. The aim of the paper is to discuss possible approaches through which 3D Internet can be studies from a film semiotic point of view.

Considered as media, films and 3D spaces resemble each other in several aspects:

i) Both films and 3D spaces are representational media, i.e., they use cultural and aesthetic conventions to create 'texts' that can exist independently of their sender (similar to books, paintings, sculpture, etc.); in contrast to presentational media that use the body as transmitter and produce acts of communication and are consequently tied to the sender and to the here and now (similar to theater, voice, body language, facial expression, etc.).

ii) Both films and 3D spaces are time-based media, i.e., they include development in time (in contrast to sculpture, architecture, painting, etc. that are articulated primarily in space). But at the same time they also include spatial composition and development in space (in contrast to, for instance, written or spoken languages that deal only with the linear aspect of construction).

iii) Both films and 3D spaces are 'multi'-media in the sense that they make use of several (sub-)media or sign systems. The French film semiologist Christian Metz points out five channels of information in film: 1) the visual image, 2) print and other graphics, 3) speech, 4) music, and 5) sound effects [cf. Monaco 81]. The same is surely true, *mutatis mutandis*, of computer based multimedia in general and of 3D spaces in particular.

iv) Both films and computer based multimedia, among these 3D spaces, can draw on the majority of the other arts (spoken and written language, graphics, music, painting, dance, etc.) for much of their meaning, aesthetic power and various effects – for one thing because they can record them. That is one of the reasons why computer based multimedia are the most semiotic complex of all media.

v) Multimedia aside, both films and 3D spaces are based on moving images as the dominant sign system.

vi) And last but not least: both films and 3D spaces are composed in three space dimensions and both are screen media that represent the illusion of three-dimensional space on a two-dimensional screen.

However, there are important differences as well:

i) [Monaco 81] writes: "Cinema is not strictly a medium of intercommunication. One seldom holds dialogues in film. Whereas spoken and written languages are used for intercommunication, film … (as well as language when it is used for artistic purposes), is a one-way communication. As a result, even the most utilitarian of films is artistic in some respect". Computer media and 3D spaces, on the contrary, are media of intercommunication. In other words, networked media resemble spoken and written languages in that they are used for intercommunication. In fact, one often holds dialogues in 3D Space (e.g. 3D chat). At the same time, multimedia and 3D spaces resemble film in that they are often artistic in some respects. This is another reason why multimedia and 3D spaces are some of the most complex of all media. Or, more precisely stated: film is a one-way-medium whereas 3D Internet is (often) two-way-communication; film is an inherently passive medium whereas 3D Internet is strongly marked by interactivity and human-computer interaction [cf. Jensen 97].

ii) Both films and 3D spaces utilize the illusion of 3D, but in film the fixed movements of the camera are controlled by the film director, in 3D space the user is able to interactively control movements and viewpoint.

iii) Finally, film is primarily an indexical medium (there is a physical connection between the images and the scene they represent) and an iconic medium (the images have a direct similarity to the object); whereas 3D space is first and foremost an iconic medium (on the assumption that the images resemble the object) and possibly a symbolic medium, because there is no existential bond between sign and object (and in some cases no direct resemblance) but only a contract or convention [cf. Jensen 93]. Thus, while film is a medium with a strong bias towards the indexical, 3D space is a medium with a strong bias towards the iconic and symbolic.

Semiotics – Basic Concepts

According to semiotics, the structure of all media – film, multimedia, 3D space – is governed by the codes that operate within it. A code is a system of signs governed by rules between the members of the user culture. Codes are characterized by the following features: 1) They have a number of units arranged in *paradigms* from which one is chosen 2) The chosen units are combined into a *syntagm*, i.e., a text or message 3) They convey meaning, which derives from the agreement among and shared experience of the user culture.

A paradigm is a set of elements from which one may be chosen to combine with elements from other paradigms to form a syntagm. A paradigm, then, is a set of units that have an overall similarity. A syntagm, on the other hand, is a combination of elements chosen from paradigms to constitute a signifying whole. In a syntagm, the meaning of a unit is determined by how it interacts with the other units, hence the same element may have different meanings in different combinations, whereas, in a paradigm, it is determined by how it is distinguished from the others. So the paradigmatic dimension is one of choice, the syntagmatic one of combination.

These two dimensions are – according to Monaco – of paramount importance for the construction of meaning in film. To produce a film, the film director has to make specific choices. When the significance of a specific shot depends on having "been chosen from a range of other possible shots" then we can speak of meanings produced on the paradigmatic axis. That is, the "sense we comprehend stems from the shot being compared, not necessarily consciously, with its unrealized companions in the paradigm, or general model, of this type of shot" [Monaco 81]. Conversely, when the significance of a specific shot does not depend "on the shot compared with other potential shots, but rather on the shot compared with actual shots that precede or follow it", that is, the other shots we do see, then we can speak of meanings produced on the syntagmatic axis. The syntagmatic aspect of film is thus associated with editing and montage (cf. below).

"These two axes of meaning – the paradigmatic and the syntagmatic –", [Monaco 81] sums up, "have real value as tools for understanding what film means. In fact, as an art, film depends almost entirely upon these two sets of choices. After a filmmaker has decided what to shoot, the two obsessive questions are how to shoot it (what choices to make, the paradigmatic) and how to present the shot (how to edit it: the syntagmatic)". And likewise when we 'read' a film, the sense of meaning, "depends on understood comparisons of the image with images that were not chosen (paradigmatic) and images that came before and after (syntagmatic)…".

In film, however, the syntagmatic dimension seems much more complex compared to, for instance, written and spoken language. [Monaco 81]: "In written/spoken languge [sic!] systems, syntax deals only with what we might call the linear aspect of construction: that is, the ways in which words are put together in a chain to form phrases and sentences, what in film we call the syntagmatic category. In film, however, syntax can also include spatial composition, for which there is no parallel in language systems like English and French – we can't say or write several things at the same time". Thus, the syntagmatic combination can unfold in time (speech), in space (painting), and in time and space (film). The Danish computer semiologist Peter Boegh Andersen (whom we draw heavily on here) therefore suggests that we speak of "sequential syntagms" [Andersen 90] when elements occur together in a sequential chain, i.e. when the syntagms have an extension in the temporal dimension; and of "concurrent syntagms" when elements occur together in a concurrent chain, i.e. when the syntagms have an extension in the spatial dimension.

The same holds true for multimedia and 3D spaces. Like all other media, a given 3D Space or Virtual World can be conceptualized as a syntagm formed from units from a host of paradigms: objects, actors, architectural design, rules, etc. Examples of concurrent syntagms would be the constellation of windows or views in the 3D browser (chat-window, window for 3D interaction, window with a list of participants, etc.) and examples of sequential syntagms would be a VR walkthrough or a *flythrough* in Quick Time Virtual Reality (QTVR). In computer media and multimedia, however, the paradigmatic axis can also include a spatial dimension for which there is no parallel in language systems or in the film medium. Owing to computer media's inherent interactive features, a situation with several mutually exclusive options in the temporal dimension is often represented as a paradigm of choices in the spatial dimension. In this case, the paradigm can not be said to be a set of elements that can replace each other in the same place and from which only one is chosen. On the contrary, all the elements in the paradigm of options are in fact chosen and realized simultaneously in the same space. As a distinctive feature of computer media, paradigms are often realized as concurrent syntagms.

Mise-en-scène, Montage, and Sound & Image

Returning to film, [Monaco 81] remarks: "In film criticism, generally, the modification of space is referred to as mise en scène … The modification of time is called montage". And he adds "the tension between these twin concepts of mise en scène and montage has been the engine of film esthetics ever since … the turn of the century". In the following, we will structure the discussion around these two key concepts diverted from film. Both mise-en-scène and montage are principles of organization. But where mise-en-scène concerns the techniques of the shot: setting up the scene, organizing the space, staging the subject in front of the camera; montage concerns the techniques that relate shot-to-shot: editing. In short, the domain of mise-en-scène is *what to shoot* and *how to shoot it*, the domain of montage is *how to present the shot*. Finally, we will supplement this with a short discussion of some of the techniques that relate sound to image.

Mise-en-scène: The Techniques of the Shot

Mise-en-scène is the techniques of the shot. In film theory, a 'shot' refers to one uninterrupted run of the camera to expose a series of frames. In the finished film, correspondingly, the shot is one uninterrupted flow of image-frames with a single static or mobile framing. The shot is thus a sort of 'minimal unit' in the film medium. In 3D space, it would correspond to one continuous 3D walkthrough or one tour in a 3D space without a change of point of view. A 'scene' or a 'sequence', on the other hand, is a larger segment of a film relating to the same logical unit of meaning, i.e., it takes place in one time and space and/or involves one complete stretch of action. In 3D space, it would correspond to a series of consecutive actions or interactions in the same time and (3D) space that can be understood as a logical and meaningful unit – without regard to change in point of view.

Mise-en-scène was originally a theater term which reaches back into nineteenth century theater. Here, the concept was applied to the practice of directing plays. The French phrase literally means 'putting in the scene' or 'staging an action'. The term crossed over to film production where it came to signify practices involved in the framing of *shots*. Now, the concept is used to signify "the director's control over what appears on the film frame", i.e. the codes that operate within the frame; or rephrased: "In controlling the mise-en-scène, the director *stages the event* for the camera" [Bordwell & Thompson 97]. Following from the term's theatrical origins, mise-en-scène includes those aspects of film that overlap with the art of the theater – notably: setting, lighting, figures, movement, appearance, and costumes – within the frame. In recent years, the filmmaker's control of mise-en-scène has been extended to a degree impossible with live actors shot in real time, first by means of animated film as seen in drawn or puppet animation, later by means of computer-generated images and animations. Consequently, settings, figures, and movements created by digital computers are also considered part of the mise-en-scène. In the context of computers and 3D spaces, we can define mise-en-scène as every element that appears in the scene – and on the screen – and that the designer can control. Naturally, aspects concerning mise-en-scène have a special relevance for the new 3D virtual worlds emerging on the Internet [cf. Jensen 98 & 99]. Here, the designer literally has to create or stage a new scene, a new environment, or a whole New World. So, in a way, it is true to say that the emergence of 3D worlds and 3D-interfaces is the fulfillment and culmination of mise-en-scène in the computer medium [cf. Andersen 97].

As it appears from the above, each of the general areas under the techniques of mise-en-scène offers the designer a range of possibilities for selection and control. However, as mentioned previously, mise-on-scène not only concerns the codes of *what is being filmed*, i.e. what is put in front of the camera, but also the codes of *how it is being filmed*, i.e., how it is being inscribed on film. Due to lack of space, we will only comment upon a couple of these codes with special relevance to 3D, viz. depth cues or the illusion of three-dimensional space: our ability to create and perceive 3D depth in 2D representation.

Needless to say, there is no real space extending behind the screen, but arrangement of the mise-en-scène and the way it is being transformed for the screen must prompt the viewer to imagine or construct that screen space. In other words, the codes of mise-en-scène must provide cues, which enable the viewer to infer the three dimensionality of the screen from the flat two dimensional images projected on the screen. Naturally, some of these codes concerning depth perception are shared with still pictures, notably photography and painting. The most important of these codes to create 3D depth in 2D representation that can be observed in both still pictures, film and 3D spaces are: overlapping planes, linear perspective, relative size (proximity and proportion), height in plane, density gradient, aerial perspective, light, shadows and saturation, and depth characteristics of lenses.

Another set of depth codes with high relevance for 3D space, which is not shared with still pictures but which is relatively specific to film, is the so-called mobile framing or camera movement: the ability to change the camera's position within the shot, so that the frame moves with respect to the framed material. In some forms of mobile framing, the camera is fixed at a certain point, but is rotated around its own axis. Because the camera and the subject are located in three-dimensional space, there are three types of movements, corresponding to the three axes that intersect the camera [cf. Monaco 81, Bordwell & Thompson 97].

In *the pan shot* (short for 'panorama'), the camera is rotated on the vertical y-axis but the camera itself does not move. In the world of 3D graphics where this rotation is often called *yaw*, a parallel can be found in QTVRs, which are essentially based on this panoramic view of a scene (up to 360-degrees) fixed at a node in space.

In *the tilt shot*, the camera is rotated on the horizontal x-axis but the camera itself does not move. This type of rotation, which in 3D graphics is often called *pitch* has its parallel in QTVRs (and Video Reality) too.

In *the roll shot*, the camera is rotated on the depth (z-)axis that corresponds to the axis of the lens (the horizontal axis that runs into the picture) but the camera itself does not move (also called *roll* in 3D graphics). This axis represents the relationship between the camera and the framed material. While the pan and the tilt shot change the framed material, the roll shot maintains the same focus of attention but turns it around. The roll shot thus destabilizes the subject as well as the horizon and the depicted space. Because of this (and perhaps because it does not correspond to any natural bodily experience in physical 3D space) it is very rarely used in film. In the province of computers and 3D, it can be observed, however, in simulation games based on car races, boat races, etc. where it is used to represent accidents, collisions, overturning, etc. And in this case – if we observe the scene from a first person point-of-view – the rotation actually corresponds to a natural bodily experience.

In addition to rotating around these three axes, the camera can be moved from one point to another within a shot in the form of *the tracking shot*, *the crane shot* and *the point-of-view shot* [Monaco 81].

In the *tracking shot*, the camera itself is moved forward, backward or in any other horizontal direction along the ground. The tracking shot thus generates a feeling of physically entering into the scene, the spatial relations between the objects in the scene continually changes, and – consequently – so does the perspective. As a result, the track shot markedly strengthens the perception of depth.

In the *crane shot*, the camera is moved in the vertical direction above the ground. In the area of 3D VWs, this technique is often used in the form of a so-called 'out-of-body' viewpoint, 'bird's eye', or 'God' view.

The concept of *point-of-view shot* is perhaps best explained with reference to literature. A story is always narrated by someone. This 'someone' can either be a person who participates as a figure in the story – in which case we speak of a *first-person narrator* – or it may be a person who is positioned outside the story – in which case we speak of an *omniscient narrator*. Film can, to a certain degree, mimic these literary codes (in this context, for the sake of simplicity, we will deal only with the images not with a story told on the sound track, cf. below). The vast majority of narrative films are narrated from an omniscient point of view. We might call this a *third-person point-of-view*. In some cases, nevertheless, we see the events from the perspective of a character participating in the story. This is the *first-person point-of-view*. In the context of the film medium, this point-of-view is, however, much more infrequent and, when used, only used on a limited scale. Monaco suggests that if the first-person rule is applied to cinema on a larger scale, it inevitably causes problems. In computer media in general and in 3D applications in particular, the first-person point-of-view has, on the contrary, already been established as a firm convention. A particular version of the first-person-view is the *subjective camera*. In this case, the point-of-view is more or less permanently attached to a character participating in the setting. In other words, you see the world, the scene through the given character's eyes. This version is extremely uncommon in films, but very common in computer media, especially in 3D applications; presumably because of the medium's inherent interactivity, which presupposes that the user controls the action and participates in the events. Examples of first-person-views of this kind – where you constantly see the (3D) world through your avatar's first-person point of view – can be found in most of the 3D virtual worlds on the Web (as well as in computer games).

In 3D graphics, correspondingly, the range of motions available to an avatar or a viewpoint is called *degrees of freedom* (DOF). There are six possible DOFs in 3D. Movements along the x, y or z axes (parallel to tracking, crane shot etc.), which determine the coordinates in the given 3D space, and rotation around any of these three axes: you can move your avatar's or virtual head's viewpoint up and down (tilt/yaw), turn it right and left (pan/pitch), or roll it from side to side (roll) [cf. Wilcox 98].

Montage: The Techniques that Relate Shot-to-Shot

While the concept of mise-en-scène refers to the 'shot', montage refers to the techniques that relate shot-to-shot. The original French phrase literally means, "putting together". Montage or editing may thus be described as the way shots are put together to make up a film and, consequently, relates primarily to the temporal dimension.

The precondition for editing is that the human receiver has a tendency to perceive two joined shots as being in some way related, and thus to infer a whole on the basis of parts. In film, these joints can be of various kinds. The most common way of getting from one shot to the next is the unmarked *cut*, the instantaneous junction of two shots, but there are a number of conventional ways of joining shot-to-shot: double exposure, fade-out, fade-in, dissolve, iris, and wipe. In the computer medium, these means of getting from one node to the next have practically exploded, owing to digital technology. A conventional program such as Microsoft's PowerPoint offers more than 40 transitions, i.e., ways of getting from one slide to another. While browsing the WWW, we have a peculiar way of getting from one node to another: the blanking out of the screen for an indefinite amount of time and a more or less slow build up of the new Web-page, i.e., a combination of cut-to-white and a fade-in. Thus the dimension of 'editing' is one of the most annoying aspects of the Web. In 3D Virtual Worlds, joints occur when the user 'jumps' or is teleported from one space to another or from one world to another. Whereas cuts and joints are frequent occurrences in film, they are more rare in 3D space. In the force field between mise-en-scène and montage, 3D Internet definitely has a bias towards the mise-en-scène.

Editing two shots together permits the interaction of qualities (graphic, rhythmic, spatial, temporal) of those two shots. This interaction can be based on differences or similarities, producing abrupt contrast or smooth continuity, respectively. In film, it is the last style of editing that has been established as predominant, in the form of so-called *continuity editing*. The basic principle of continuity editing is to produce seamless transitions from shot to shot – so-called 'invisible cutting' – so that one event follows 'naturally' from another and time and space are logically represented. The prime purpose is to maintain immediacy, to concentrate attention on the ongoing action, that is, to tell a story coherently. This is done by a multitude of different techniques: match cut (which links two disparate scenes via a graphic match or continuity), rhythmic relations of shot lengths, spatial continuity (establishing shot, the 180-degree rule), temporal continuity, and – most generally – by creating a smooth flow and avoiding clashes from shot to shot [cf. Monaco 81]. All of these techniques are also pertinent to 3D spaces.

The relation of sound to image

Sound as a supplement to images is often considered a secondary factor by the viewer. Nevertheless, sound is a powerful technique that influences and codifies the experience in many ways. Sound can guide our attention within the image and focus our perception by pointing to things of particular interest. And sound can thus actively shape the viewers perception, interpretation, and understanding of images. In 3D spaces, in like manner, sound is an important factor, since it can bring about an overall sense of a realistic or convincing environment.

The term *'sound'* usually covers three types of aural phenomena: *speech*, *music* and *sound* effects. In the following we briefly introduce a typology based on the relationship of sound to image, having its source in film semiotics, but of pertinence to 3D spaces as well. Sound has spatial as well as temporal dimensions. It has a spatial dimension because it comes from a source. In this dimension, at the most general level, sound is divided into diegetic and non-diegetic sound, based on the identification of the source of the sound.

Non-diegetic sound is sound that is represented as coming from a source that can not be located in the scene, space, or world. It is often called 'sound over' because it comes from outside the represented visual space of the events. Non-diegetic sound can be subdivided into: 1) *Music* – so-called 'background music', 'movie music' or 'wallpaper music' – that does not issue from, but is added to the scene. 2) *The voice of the narrator*, in this case a heterodiegetic, omniscient third-person narrator, that introduces time, place, and characters but can not be recognized as belonging to any of the characters in the space. And finally 3) non-diegetic *sound effects*.

Diegetic sound is sound that is represented as coming from a physical source in the visually represented space or world. Diegetic sound can be subdivided into: 1) *Actual sound*, i.e., sound that the characters in the given space can or would be able to hear. In other words, we perceive the source of the sound as actually present in the here-and-now of the scene. Actual sound can be subdivided into on-screen and off-screen sound, cf. below. 2) *Subjective sound*, i.e., sound that can be heard only by a single character in the scene (inner voices etc.). And 3) *the voice of the narrator*, in this case a homodiegetic, first-person narrator, that introduces time, place, and events, *and* can be identified as belonging to a character in the represented events.

Diegetic actual sound can be either on-screen or off-screen.

On-screen sound refers to diegetic sound, perceived as coming from a source that is visible within the frame at the time the sound is heard, e.g. we hear a voice and at the same time we see the lips of an avatar move.

Off-screen sound refers to diegetic sound coming form a source that is not immediately visible within the frame at the time the sound is heard; nevertheless the source is perceived as being present in the scene at the given moment, only outside the actual frame. In 3D applications, environmental sound would be a case in point.

Consequently, off-screen sound can indicate space reaching beyond the immediately perceivable frame and may be used to cue the user's attention on and expectations about off-screen space. This technique is very useful and effective in 3D-applications. For instance, in certain networked 3D shoot'em'up'-games you often hear the footsteps of your opponents before you are able to actually see them in the frame.

Another feature of diegetic sound with strong pertinence and applicability to 3D space is the possibility of *sound perspective* [Bordwell & Thompson 97]. Corresponding to the depth cues that constitute visual perspective, it is possible to create a sense of spatial depth, distance, or location that in turn can model a kind of three-dimensional sound environment. It goes without saying that sound perspective can be produced by stereophonic sound or, better still, surround sound channels. Utilizing these techniques, it is possible to represent a sound's placement in the three-dimensional space – on-screen as well as off-screen. Sound perspective can also be produced simply by volume, because volume by a conventional code is related to the perceived distance. A loud sound is thus perceived as coming from the acoustic foreground close to the listener, a quieter or softer sound is sensed as located in the acoustic background far from the listener.

In the same way that sound has a spatial dimension because it is perceived as linked to a source, sound has a temporal dimension because it is perceived as linked to visual events that take place at a specific time. The most common relation between sound and picture in the temporal dimension involves synchronization [Monaco 81].

Synchronous sound refers to sound that is matched with the projected image, i.e. we perceive the sound at the same time as we see the source produce it. Because of this definitory precondition, synchronous sound relates primarily to diegetic on-screen sound. However, it is also possible, in a more unrestricted manner, to speak of synchronous sound applied to off-screen sound, subjective sound, the voice over, or even applied to background music, sound effects etc.

Asynchronous sound refers to sound that is not matched with the projected image, in short: sound that is *out-of-sync*. This, of course, refers first and foremost to technical inaccuracies and time lags, which are not uncommon in this early stage of the technology. But asynchronous sound can also be utilized for expressive and aesthetic purposes. Again, this type of sound primarily has a bearing on on-screen diegetic sound. In this case, correspondingly, it is possible in a more vague manner to speak of asynchronous off-screen sound, asynchronous voice-overs, as well as asynchronous, or non-contemporary, background music, sound effects, etc.

Conclusions & Perspectives

This paper has analytical, theoretical, methodological as well as practical implications. It is of interest in relation to the analytical and theoretical understanding of this new and rapidly growing medium and in relation to methods of examining these phenomena. The study shows that concepts and categories from the field of film semiotics are highly relevant to the area of 3D applications and it indicates that the concepts presented here can form the building blocks for a semiotics of 3D Cyberspace. However, it also has implications for construction and design aspects since the design of 3D spaces must be based on actual knowledge of the conditions and possibilities for the construction of signs, codes and meaning in the new medium.

References

Andersen, P.B. (1990). *A Theory of Computer Semiotics*. Cambridge University Press.
Andersen P. B, B. Holmqvist & Jens F. Jensen (1993). *The Computer as Medium*. Cambridge University Press.
Andersen, P. B. (1997). Film og Multimedier, in: Bo Fibiger (ed.): *Design af Multimedier*. Aalborg University Press.
Bordwell, D. & K. Thompson (1997): *Film Art*. New York.
Jensen, Jens F. (1993). Computer Culture, in Andersen, Holmqvist & Jensen. *A Theory of Computer Semiotics*. Cambridge.
Jensen, Jens F. (1996). Mapping the Web. *Proceedings of WebNet 96*, AACE, Charlottesville.
Jensen, Jens F. (1997). 'Interactivity' – tracking a new concept. *Proceedings of WebNet 97*, AACE, Charlottesville.
Jensen, Jens F. (1998). Interaction and Representation in 3D-Virtual Worlds. *Proceedings of WebNet 98*, AACE.
Jensen, Jens F. (1999). From 'Flatland' to 'Spaceland'. Spatial Representation, Enunciation and Interaction in 3D-Virtual Worlds. *WebNet Journal. Internet Technologies, Applications & Issues*, Vol. 1, no. 1, Jan.-March 1999.
Monaco, J. (1981). *How to Read a Film*. Oxford University Press.
Wilcox, Sue Ki (1998). *Guide to 3D Avatars*. Wiley Computer Publishing.

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Experiences In Shaping The Virtual Lecturing Hall In An International Environment

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Abstract: The paper presents the experiences in shaping virtual lecturing call collected through two years trial within European funded projects dealing with CSWC technology over broadband networks. The models developed and tested in trials with audience in three continents are evaluated and guidelines for further development are briefly described.

1.Introduction

The purpose of this paper is to present the results on large-scale trials of broadband teleconferencing systems carried out during the period 1996 to 1998 that were designed to help shaping virtual lecturing hall. The second objective of the paper is to provide some pointers for future use of this technology within tele-working and collaborative learning field of applications. The systems deployed were designed to support interaction between distant groups of people. At each of the participating locations there was a meeting room or a conference/lecturing hall, with any number of people from two too more than a hundred. It is important here to be stressed that the trials were conducted in two types of environments: a) collaboration of *multiple groups and b)* collaboration of a *single group* whose members are individually dispersed.

There were 12 trials carried out by two collaborative R&D projects subsidised by the European Union (EU):project NICE, see http://www.berkom.de/nice during 1996-7 and project EXPERT see http://www.snh.ch/expert during 1998. Both of these projects were part of the EU's ACTS (Advanced Communications Technologies) Programme. The trials followed four years of earlier work by Spanish and Portuguese teams in the ISABEL and IBER projects, beginning in 1992 see http://www.infowin.org.

A consortium of partners from EU (European Union) and EEA (European Economic Area) states, assisted by collaborators in Canada, Switzerland, Eastern Europe, Russia and Japan did the work. There were 18 EU/EEA partners, one collaborator each from Canada and Japan, and 11 collaborators from Central and Eastern Europe (CEE) and the newly independent states of the former Soviet Union countries (NIS), (see Gabrijelcic, 1996). The participants were a mixture of private telecommunications operators, academic network operators, universities and governmental agencies. The common goal was to provide enough experience that will enable commercial exploitation of the developed applications, knowledge and services. It will be apparent from the from examples that will be later described that the trials (12 in a period of 2 years) were on a large scale, meaning collaboration of multiple groups dispersed over 3 continents and 15 to 20 sites. There were several reasons for this, partly technical and partly social. It is inherent in the idea of teleconferencing and tele-lecturing to serve widely dispersed users who cannot travel to a central auditorium, for reasons of time or money. Large number of sites were part of the trials because there was need to investigate the problems of scaling up, in the network, in the application software and in the organisation and management of people. The requirement to demonstrate to a big audience also contributed to the wide range of locations. Finally, there was a secondary objective: to transfer knowledge and experience to the colleagues in the CEE and NIS countries so as to create a common capability in this subject.

2.Underlying Network Infrastructure Used In The Trials

To reach the desired locations a variety of bearers: terrestrial fibre, satellite links (both SMS and TDMA), microwave and radio were put together. This was primarily a financial and organisational task, to negotiate the use of links for short periods at prices that could be afforded by the projects. Our consortium was constructed so as to include carriers like Deutsche Telekom and EUTELSAT. Support was provided also from other EU-funded projects such as JAMES and GAMMA who provided pieces of the infrastructure. The result of this ad hoc assembly was that the bearer network was with differing bandwidths in different sections. The core network was either 6Mbit/s or 4Mbit/s, the satellite links mostly 2Mbit/s and other links ranged down to as low as 384kbit/s.

The infrastructure was mainly based on ATM technology, by use of a mix of publicly available ATM services and private switches (see Van den Berg 1997). The ATM service class was Constant Bit Rate (CBR) throughout. The ATM flows over the SMS satellite links were managed using a distributed switch technology known as CADENZA supplied by Alcatel Space & Defence. Over the ATM PVC classical IP was ran. Limited experiments were done with LANE and MPOA technology. The IP structures were usually a mixture of multicast and unicast. The IP network was also used for regular Internet services like WEB applications and IRC

The networks as described above were to provide full interactivity, with all sites having symmetric video and audio capabilities. Outside of the core network were performed experiments with other facilities -

- receive-only watch points within private IP network
- gateways broadcasting to public MBONE
- interactive links outside of core sites, using ISDN

Over this infrastructure a tool enabling the trials was used described in the session that follows.

3. The Application Software

The application software that provided the required support for the trials was the software package called ISABEL, developed at the Politechnical University of Madrid (see Quemada 1995 and ftp2.dit.upm.es/pub/Isabel). ISABEL is enhanced video-conferencing tool designed to operate mainly over broad-band networks with ATM technology. ISABEL provides N to N bi-directional communications for all media exchanged, supports auditorium interconnection and has specific modes for distributing the different types of interactions existing in a, different type of trial like Conference, Workshop or Seminar. ISABEL features multicast efficiently and as a consequence the increase of sites on the network resources is minimal. This enables easy scaling of organised events. ISABEL provides also channels for in-receive-only mode of operation (WatchPoint). This feature enables spread up of the prepared content for the trial to an unbounded number of non-interactive sites at the expense of no extra bandwidth which is especially valuable for countries or region with rather modest communication infrastructure like NIS (the New Independent States). The software acts in two modes: unicast and multicast which is preferred option. The multicast option is used in an advanced agreed network with set up conference management centre that controls the network and monitor the distributed event. The other mode - unicast is used when the participant have agreed to set up a full mesh of point to point circuits. ISABEL was developed on SUN systems but it was later ported to SGI and Linux, (see Peter Akesson 1997).

4. The Models Developed

A .Virtual conference hall

ISABEL was developed as tool that enables distributed meeting or distributed conference/lecturing to selected audience. The notions of "meeting" and "conference" overlap and are not useful to make a sharp distinction between them. The key characteristic is that there is some agreed or imposed agenda to which all the attendees are supposed to relate in some way. As the numbers of persons involved gets beyond a small group, a chairman is necessary to manage the agenda and moderate the interactions. With ISABEL the participant are seeing at the screen in advance prepared lectures with usually use of Power Point slides or some other running application e.g. from a WEB page. After the presentation is over the *question mode* appears on the screen and every person from a participating site can invoke his image to appear on the screen and to enter in a dialogue with the lecturer by pressing the button representing the site code.. Other participants can enter also in the discussion and invoke a panel. Other mode of interaction is the use of common *whiteboard*. This type of model was named the *virtual lecturing hall* model as it aims to provide chairmen/lecturer, speakers/contributors and audience in a set of distributed locations with the same facilities as they would have in a single location. This means not only that the audience is distributed but that the chairman/lecture and the speakers/contributors can also be in any of the locations (see Chas P., 1996).

B. Publish-and-subscribe channel

ISABEL can support an alternative model of use and for that reason the techniques borrowed from the world of television combined with teleconferencing software were investigated in the trial enabling access to much larger audience. In this model the audiences was offered a channel in which a sequence of programmes was run, rather like a TV channel. For that reason this model was called a *publish-and-subscribe channel*. On one side of the channel were the publishers of programmes, which could be broadcast from one or more of the interactive sites. On the other side of the channel were the organisers of local meetings and conferences, who arranged to incorporate particular programmes from the channel into their own local events (see De Isidro 1997).

5.The trials

There were 10 trials in the period of 3 years. Two of them represent the typical events organised by the project NICE and EXPERT: the CEE/NIS event in November 1997 and Global360 in December 1998 (Global360) see http://www.isabel.dit.upm.es/.

A. The CEE&NIS event and the technical audit

One of the objectives of the NICE project was to transfer knowledge and experience to the CEE and NIS countries so as to create a common capability in this subject. For this reason an event was organised in 1997 and that was completely performed by the Central and Eastern European partners only. The network management centre was set up in Prague within the premises of CESnet and the programme was prepared by the CEE/NIS partners. Four main sites where speakers gave talk had also their local events. Two panels were also part of the programme that applied the conference hall model. Another interesting trial was the Technical Audit in Brussels. For that event 3 partners took part in the conference hall model and special application – the Top Level Certification Authority for Slovenia (SI-CA) which is a part of the European Public Key infrastructure was presented within the conference hall model. The services of the SI-CA see http://www.e5.ijs.si/si-ca/ from Ljubljana were demonstrated for the technical auditors sitting in Brussels using the conference hall model.

B. Global360, December 1998

Global360 was operated as an extension of the European Commission's Information Society & Technologies conference and exhibition (IST98) in Vienna, from 30th November to 2nd December 1998. It used the publish-and-subscribe model to provide a way of widening the audience for IST98 and to inject into IST98 demonstrations and discussions from remote sites in the special IST98 session published as Digital Theatre. Global360 ran 30 hours of continuous programming over three days. Six of the parallel sessions from the IST98 conference were transformed into teleconferences operating over Global360. The Digital Theatre session showed the demonstration from external sites and acted as a studio for the Global360 moderator as well as the source of a number of programmes prepared within Global 360 channel. Outside Vienna there were parallel events in other cities, such as Basel and Ljubljana, with content from the IST Conference – Living and working in the Information Society. The local event in Ljubljana was organised in the Slovenian National Assembly where members of the Parliament and other political people had opportunities to interact with the audience. Global360 interconnected 19 interactive sites, of which no less than 17 acted as sources of programmes. The network of Global 360 is presented on Fig.1

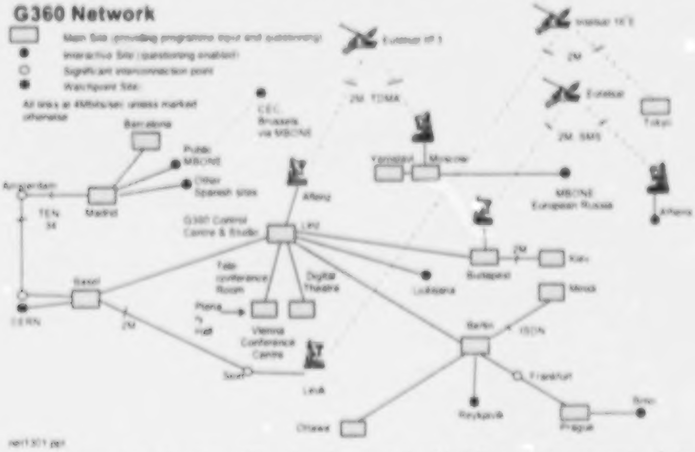
G360 Network
Interactive Site (questioning enabled)
Significant interconnection point
Watchpoint Site
2M TDMA
CEC Brussels via MBONE
Barcelona
Public MBONE
Other Spanish sites
Amsterdam
TEN 34
Madrid
Aflenz
G360 Control Centre & Studio
Linz
Moscow
MBONE European Russia
2M
2M SMS
Tokyo
Athens
Budapest
2M
Kiev
Ljubljana
Minsk
Basel
CERN
2M
Tele conference Room
Digital Theatre
Vienna Conference Centre
Berlin
ISDN
Frankfurt
Leuk
Reykjavik
Prague
Brno
Ottawa

Fig.1. The Global 360 network

Sites were spread across Western and Eastern Europe and in Canada, Russia and Japan, see Fig.2. This was the second Global360 event run by the consortium and by this times both the ISABEL software and the organisation had matured to a point where TV-style production had become feasible. In the distributed event 28 different producers (15 of them outside of the project EXPERT) created the programmes. Control scripts prepared by the program manager for the programmes were automatically converted and loaded into the system, so when the program was ran the director and operators could concentrate on exception conditions. Professional designers were used to create screen graphics for continuity and titling and a professional TV moderator was hired. Other features were: extensive use of side channels for real-time command and control, IRC for technical co-ordination and a telephone audio-conference for co-ordination between the director and the local programme managers was also used.

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Fig.2 Canada, Japan, Austria and Slovenia in Global 360

6.Summary of Results

A. Usability of the developed models

In the course of the trials ISABEL has been permanently improved and by the end of the trials got quite good and rich functional capability. This has been demonstrated by the way in which successfully was shifted from its original model of use (the virtual lecturing/conference hall) to a radically different one (the publish-and-subscribe channel). The most recent trials have shown that ISABEL's reliability is now quite good and could be even better if it is run on a commercially managed platform which is now being negotiated. However, the current public domain version is an academic software and lacks proper packaging, documentation but an increasing number of educational and research institutions are using it as a working tool (in Canada e.g.). The trials have in addition shown that ISABEL systems can also be open to non-ISABEL users. A number of demonstrations were performed using remote ISDN H.321 feeds into ISABEL sites[1] (see also Fig.2), which were useful for including interactive contributions from sites without broadband links. Public gateways broadcasting to the MBONE and to the Web were implemented and tested, so that a much wider audience could follow the distributed events. The experience with heterogeneous networks and external sites shows that it is feasible to run a single teleconference with different grades of service, according to the facilities available at each site.

B. Scalability

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[1] The ISABEL site hands over its video input to the external feed. Alternatively it can make up a composite picture with both remote and local images.

The large-scale events performed within the trials helped to understand what aspects can be scaled up in a

number of sites simultaneously interacting on screen, 15 to 20 is the current number. Scalability is also related

important issue to understand the technological features as well as the human organisation to deliver a satisfactory service to both the performers and audiences in relation to possible new services. The technology

chairmen, but it is not by itself the solution.

C New medium - new issues

others. For example: *distance teaching*
relationships of teachers with individual pupils, implying additional channels and data records; *Corporate*
require intelligent access to, and manipulation and marking of corporate and external data sets, linked to the progress of the teleconference.

Final Conclusions

There is still need to explore the scalability of this technology in relation to a number of models of use and from

primitive level of knowing the identities of the people in the meeting. In such an environment the relevance of the participants to the agenda is more important than their number. Security issues despite that basic security

gathered experience shows that when offered it people often do not use it. The whole question of the stimulation and management of interactivity needs further investigation and experiment with different models

is certainly the cost benefit. Clear models and schemes are needed this to be properly defined and evaluated.

8. References

,D., Jerman-Blazic, B., NICE-GLOBAL, an ATM exercise for high speed networking applications.
Ljubljana, Slovenia

Van den Berg, M.,
operation, 2^{nd}
Proceedings

J. Pavon, A., M.,Moreno, J., DIT-UPM, P.L.,Rodriguez, Lagarto,
Bastos, J., Domingues, J., Tele-education Experience with the Isabel Application. Proceedings, IDC

Akesson, A.K., S.S., Van den Berg, M., Buitenhuis, T., , Domingues,
Gabrijelcic, D., Grun, G., De Gordejula, R., Laorden, J.,
Llarden Marcheti, L., Quemada, J., Gerard Snip, J., Wernekes, L., Global360

Chas, P., De Gordejuels, R., Horbat, M., eds), , eds),
Velayos, H., eds), Validated Configurations for Conferencing and High Speed File Transfer,

De Quemada, J. Zeiler, T., Hellwig, C., (ed.), Provision of Common services by National Hosts,

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Collaborative rating system for web page labeling

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Abstract: In this work, a collaborative platform for Internet content selection is proposed. After the execution of the collecting and extracting phases of the platform, the characteristics of all rating groups are learned and can be used to help users to determine which group is suitable for joining. We also design a questionnaire to understand the opinions concerning the Internet content selection of users. According to the statistics of 600 answers of our designed questionnaire, over 72% answers would support the collaborative platform for Internet content selection. Therefore, an enhanced architecture of the collaborative rating system by including one more phase, named distributing phase, to distribute the rating information by using the proxy-based labeling bureau, is further given. Based upon the enhanced architecture, we are proposing a plan to construct a national project, named "Collaborative Platform for Internet Content Selection on TANet", in Taiwan.

1. Introduction

In recent years, due to the rapid growth of the amount of web pages, web becomes an important media for information communication. It seems that some regulation or content selection for Internet is necessary due to the inappropriate information on Internet.

Some rating systems today were constructed with databases, but it seems almost impossible to rate all pages by human experts due to the extremely large amount of Internet contents. Another approach, the PICS (Platform for Internet Content Selection, *http://www.w3.org/PICS*) protocol proposed by W3C (World Wide Web Consortium, *http://www.w3.org*), provided a systematic and complete architecture for document rating system.

However, to solve the problems that PICS protocol faces, a collaborative platform for Internet content selection is proposed in this work. We first collect the ratings made by the huge amount of users on Internet in the collecting phase. And then, useable rating information of each page is extracted in extracting phase by using *Weight Adjusting Algorithm*. Besides, the characteristics of rating groups are learned by using *Rating Group Discovery Algorithm* to help users to determine which group is suitable for joining.

We also design a questionnaire to understand the opinions of users. According to the statistics of 600 answers, up to 80% answers agree the promoting of Internet content selection, and furthermore over 90% of them would support the collaborative platform for Internet content selection. A national project, named "Collaborative Platform for Internet Content Selection on TANet," is planed based upon our architecture, and one more phase, named distributing phase, is used to distribute the rating information by using the proxy-based labeling bureau.

2. Background

A survey by Georgia Tech concluded that censorship on Internet is mostly concerned by Internet users[see Georia Tech. 1996]. In fact, different countries with different cultures seem to apply different strategies on Internet content regulating[see Peng 1997]. In [Ellickson 1991], these strategies are divided into five main types: personal ethics, contractual provisions, social norms, organization rules, law, and from liberal to rigid.

PICS protocol is proposed by W3C organization and provided a systematic and complete architecture for document rating system. In addition to the syntax of rating labels, PICS provides the methods of rating and labeling for users.

The rating information can be provided by two methods, self-labeling or third-party labeling. In self-labeling method, the rating information is provided by the content providers for each web pages. In third-party labeling, the rating information is provided by specific voluntary or non-profit organizations.

Once the source of rating information is decided, the most related category should be chosen. After a rating category has been chosen, the rating opinions of rating information providers will be converted into PICS syntax-compliant labels.

There are two methods to distribute the labels. First, the rating labels can be added into the META tag of the HTML. No more requests for rating information will be needed. Second, the labels may be stored in an existing or a newly created labeling bureau, and filtering software will send requests to the labeling bureau to get corresponding rating information. According to the rating information, rating filtering software will decide the access rights of users.

RSAC (Recreational Software Advisory Council, *http://www.rsac.org*), an independent and non-profit organization based in Washington, D.C, empowers the public, especially parents, to make informal decisions about electronic media by means of an open and objective content advisory system [see W3C 1999]. RSACi system [see PICS 1999, RSAC 1999, and W3C 1999], following PICS labeling protocol, was developed by RSAC organization to regulate the contents on Internet. As shown in [Tab. 1], four categories with five levels are defined in RSACi system.

	Violence Rating Descriptor	Nudity Rating Descriptor	Sex Rating Descriptor	Language Rating Descriptor
Level 4	Rape or wanton, gratuitous violence	Frontal nudity (qualifying as provocative display)	Explicit sexual acts or sex crimes	Crude, vulgar language or extreme hate speech
Level 3	Aggressive violence or death to humans	Frontal nudity	Non-explicit sexual acts	Strong language or hate speech
Level 2	Destruction of realistic objects	Partial nudity	Clothed sexual touching	Moderate expletives or profanity
Level 1	Injury to human being	Revealing attire	Passionate kissing	Mild expletives
Level 0	None of the above or sports related	None of the above	None of the above or innocent kissing; romance	None of the above

Table 1: RSACi rating categories and level descriptors

3. Collaborative platform for Internet content selection

To obtain the rating information of all web pages by self-labeling or third-party labeling seems too ideal to apply. The followings are three possible reasons.

- No obligation for content providers to provide the rating.
- Impossible to rate all documents by voluntary or non-profit organizations due to the extremely large amount of documents.
- Hard to design an acceptable automatic rating system.

A collaborative rating system is then designed to solve the above problems, and its architecture is presented in [Fig. 1]:

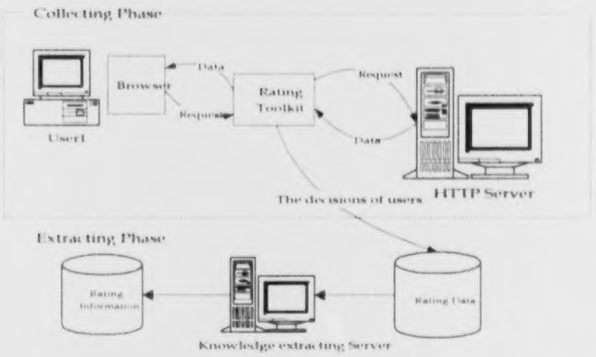
Collecting Phase
User1
Browser
Data
Request
Rating Toolkit
Request
Data
HTTP Server
The decisions of users
Extracting Phase
Rating Information
Knowledge extracting Server
Rating Data

Figure 1: The architecture of the collaborative rating system.

3.1 Collecting phase

A rating software, named *Rating Toolkit* (*RT* in short) is built to assist volunteer to rate web pages. Before using *RT*, voluntaries must firstly choose a rating category, and then provide huge amount of rating data easily. It seems most likely that the documents on Internet can be rated more efficiently and accurately.

There are a variety of ways to divide contents on WWW into several categories. Users can either follow an existing rating category to rate web pages or rate web pages with new rating category if no appropriate category can be applied. Similar to the USENET news group, a new interesting subject can be built up and added with some certificate.

As shown in [Fig. 2], user first needs to make a registration on the specific Web site by providing some basic information, and then download *RT*. An ID number will also be given to identify user when he/she provides rating.

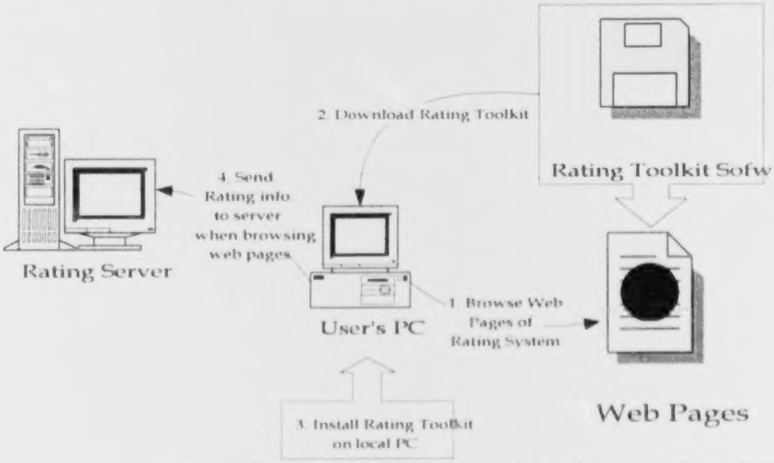
2. Download Rating Toolkit
Rating Toolkit Sofw
4. Send Rating info to server when browsing web pages
Rating Server
User's PC
1. Browse Web Pages of Rating System
Web Pages
3. Install Rating Toolkit on local PC

Figure 2: The downloading, installation and operation flow of RT.

3.2 Extracting phase

The purpose of extracting phase is to extract useful rating information from rating data provided by users. The entire flow for extracting phase is shown in [Fig. 3].

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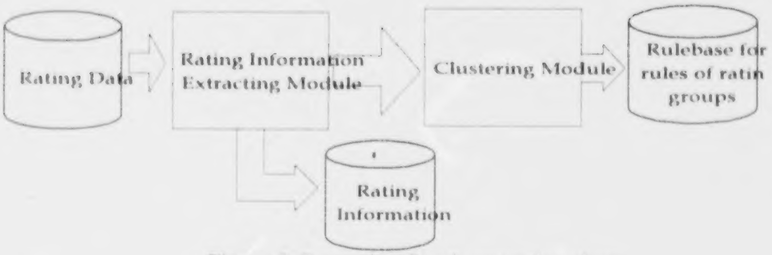
Rating Data
Rating Information Extracting Module
Clustering Module
Rulebase for rules of rating groups
Rating Information

Figure 3: Processing flow in extracting phase

To extract useful rating information from rating data provided by users, there are at least two different methods: Averaging method and Voting method. Since the users may easily make their decision by the help of the description of each level, a weighted voting method is used in our collaborative rating system.

We would like to note here that for each web page only the last rating of a user will be considered. Each time when sufficient rating data is collected, the extracting phase will be iteratively executed. The level with maximum weighted vote will be treated as the resulting rating level of this page, where the weighted vote of this level can be obtained by the following formula:

$$S_i = S_i' + \sum W_j,$$

where S_i' is the weighted vote of level i in previous iteration, which is 0 at first iteration, and W_j is the weight of user j who rates the page as the level i. Once the content of web page is modified, S_i' will be ignored by resetting as 0.

The following *Weight Adjusting Algorithm* is proposed and will be executed in each iteration to reduce the influence of the participant if whose rating data is much different from the others.

Weight Adjusting Algorithm:

Notations: represents the sum of all votes for a given page P.

l represents the actual rating level of P.

N_i is equal to the number of votes for rating level i of P.

U_i represents the set of users who rate P as level i.

ρ is the threshold for low ratio.

User name	Total#	Noise#	Weight

is the part of profiles for all users, where *Total#* is the number of pages this user has voted and *Noise#* is the number of votes belonging to the levels with ratio $< \rho$.

Step 1: Evaluate the ratio $\gamma_i = N_i / \sigma$ for each rating level i □ l.

Step 2: If $\gamma_i < \rho$, then increase *Noise#* of u by 1, $\forall\, u \in U_i$.

Step 3: Increase *Total#* of u by 1, $\forall\, u \in U_i$.

The new weight for each participant can be recalculated using the formula below,

$$weight = (Total\,\# - Noise\,\#) / Total\,\#.$$

The *Weight Adjusting Algorithm* focuses on the majority only, but there may exist other opinions which can't be ignored. A clustering method is proposed in this section to find out some general relation between rating tendency.

First choose some popular websites as benchmark, which have been rated by hundreds of participants. A rating vector with length equal to the number of the above websites is defined to represent his/her behavior, where each element in the vector contains the corresponding rating data.

The distance between rating vectors may be used to represent the difference of users' opinions. For each group partitioned by some clustering algorithm, its characteristics can be learned using some symbolic learning algorithm. And the algorithm was shown below.

Rating Groups Discovery Algorithm:

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Step 1: Find out *k* most popular web pages, denoted as a benchmark.
Step 2: For all users rating all web pages in benchmark, construct their rating vectors.
Step 3: Partition these vectors into several disjoint groups by some clustering algorithm.
Step 4: Choose some symbolic learning algorithm and set the training attributes for each group by using the personal information of the group's participants.
Step 5: Apply the symbolic learning algorithm to find out a general rule to present the characteristics of this group.
Step 6: Repeat steps 4 to 6, until all groups have been considered.

After rating groups are clustered, all the rating participants including the new comers will be notified about the characteristics of all groups. This could help the new comers to determine which group is suitable for joining.

4. Experiments and Implementation

Internet services were introduced to Taiwan users in middle 1992. Up till January 1999, there are over 3,000,000 user accounts on Taiwan Internet. There is a national project, "TANet to K12 Schools" will construct campus network for K12 schools to directly connect TANet (Taiwan Academic Network, as shown in [Fig. 4]) and let K12 student use the services on Internet.

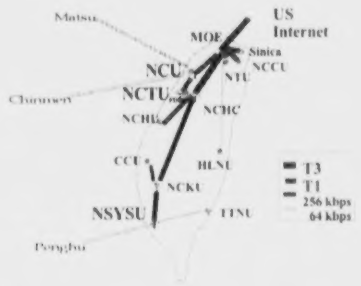
Matsu
US
Internet
MOE
Sinica
NCCU
NCU
NTU
Chinmen
NCTU
NCHU
NCHC
CCU
HLNU
NCKU
NSYSU
TTNU
Penghu
T3
T1
256 kbps
64 kbps

Figure 4: Taiwan Academic Network (TANet)

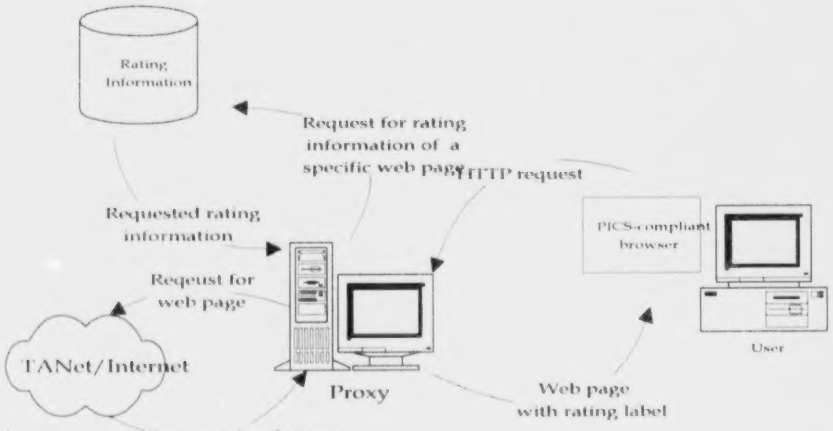
Rating
Information
Request for rating
information of a
specific web page
HTTP request
PICS-compliant
browser
Requested rating
information
Request for
web page
User
TANet/Internet
Proxy
Web page
with rating label
Requested web page

Figure 5: The architecture of the planned collaborative platform in Taiwan.

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According to the statistics of 600 answers of our designed questionnaire, up to 80% answers agree the promoting of Internet content selection. Among the answerers agreeing to promote Internet content selection, about 70% answerers are willing to be the rating volunteers to assistant the work of Internet content selection.

Now, we are planning to construct a national project, named "Collaborative Platform for Internet Content Selection on TANet," based upon the architecture of this paper. In this project, the proxy-based labeling bureaus will be constructed in three national universities, NCU, NCTU, and NSYSU, located in northern, central, and southern parts of Taiwan, respectively. The architecture of the enhanced proxy is shown in [Fig. 5].

5. Conclusion

In order to solve the problems of today's rating system, a collaborative rating system is designed. The system first collects the ratings made by the huge amount of volunteers on Internet and then extract the rating information or label of each page from the rating data obtained by using *Weight Adjusting Algorithm*. Next, *Rating Groups Discovery Algorithm* is used to cluster rating groups, and finally the characteristics of all rating groups could help users to determine which group is suitable for joining.

According to the statistics of 600 answers of our designed questionnaire, up to 80% answers agree the promoting of Internet content selection, and furthermore over 90% of them would support the collaborative platform for Internet content selection. Therefore, we propose a plan to construct a national project, named "Collaborative Platform for Internet Content Selection on TANet," based upon our architecture. In this project, one more phase, named distributing phase, is used to distribute the rating information by using the proxy-based labeling bureau. Based upon our architecture, not only the rating information but also the characteristics of the rating groups could be shared among the users on Internet.

Reference

Ellickson, R. C. (1991). *Order without law: how neighbors settle disputes*, Harvard University Press.

Georia Tech. (1996). GVU's 6th WWW survey, *http://www.cc.gatech.edu/gvu/user_sruveys/ survey-10-1996/*.

PICS (1999). Platform for Internet Content Selection, http://www.w3c.org/PICS.

Peng, H. A. (1997). How Countries Are Regulating Internet Content, *INET'97 proceeding*.

RSAC (1999). Recreational Software Advisory Council, *http://www.rsac.org*.

W3C (1999). World Wide Web Consortium, *http://www.w3.org*.

Acknowledgements

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A Study of Students' Perceived Learning in a Web-based Online Environment

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Abstract: The purpose of the study was to find what factors were perceived to be associated with students' perceptions of learning in online courses. Survey data were collected from students enrolled in 78 courses offered through the SUNY Learning Network in the fall of 1997. Correlation and multiple regression analyses were employed. The dependent variable was students' perceived learning that was correlated with eleven independent variables. Results indicated that the amount of student-instructor interaction and the online discussion activity played an important role in predicting students' perceived learning. The implication of this finding is that it is not only important to create an interactive environment for learning, but also important to design discussion activities that can trigger rich and meaningful online discourse.

1. Introduction

As more and more college courses are offered on the World Wide Web, either partially or entirely, quality of instruction and learning is becoming increasingly an issue that needs to be addressed. It is without doubt that the Web is an unprecentedly rich and convenient medium for instruction and learning, yet, this new medium at the same time poses so many unknown aspects that demand an immediate investigation to ensue quality of instruction and learning. We do not know how various learning activities of a course and the instructor's behaviors are perceived to be related to students' learning achievements. Thus far few studies back their discussions by statistically examining the relations between various factors and students' perceived learning in an entirely Web-based environment (see Jiang, 1998). This study was designed to examine the relations between them. The study used survey data collected from students enrolled in 78 courses offered through the SUNY Learning Network in the fall of 1997. The purpose of the study was to find what factors were perceived to be associated with students' perceptions of learning in online courses.

2. Methodology

The study used survey data collected from 78 Web-based courses delivered through the State University of New York Learning Network in the fall of 1997. Since these 78 courses were in different subject areas and at different levels, it was not possible to use a generic instrument to measure students' learning achievements. Thus, a survey was used to achieve the purpose. An electronic survey, consisting of 14 questions, was administered to all students enrolled in the 78 courses of the fall 97 term. Altogether 287 students responded to the survey; the response rate was 58%. This response rate was based on those students who enrolled and finished the courses, excluding students who dropped off or remained inactive through the semester. This procedure is considered as providing a more direct indicator of a method's response-inducing capabilities than do other methods (Dillman, 1978, Anderson, 1997).

Correlation and multiple regression analyses were employed. The dependent variable was students' perceived learning. Eleven independent variables focused on the contributions of two major online learning activities, two instructional behaviors, students' interactions with instructor and fellow students. Selection of variables was based on the concepts of collaborative online learning (Harasim, 1990; Kaye, 1992; Hiltz, 1990; McConnel, 1992; Simon, 1992; Hartman et al., 1995; Fabro, 1996; Lundgren-Cayrol, 1996; Berge, 1997), Vygotsky's (1986) interaction theory, Collins et al.'s (1991) cognitive apprenticeship. We also took into consideration the design of SLN courses (see Jiang, 1998). The variables used in this study are summarized in Table 1. Variables for the correlation analysis.

Table 1. Variables for the correlation analysis (N=287)

Perceived learning	Perceived instructor behavior	Perceived Student behavior	Perceived contributions of learning activities	Other variables
perceived learning	instructor-student interaction	student-student interaction	online discussion	learning style
	instructor-student communication	student-student communication	written assignments	prior computer competency
	instructor evaluation			time spent on a course
	Instructor responses			

2. 1 Correlation analysis

Results of correlation analysis showed that all the independent variables except one were significantly related to perceived learning (see Appendix: Table 2. Interrelations among the variables for the study). The variable that was not related to perceived learning was prior computer competency. This supports results from our survey on the ease of use of technology (Jiang, 1997). Results of that survey indicated that the majority of the respondents thought the SLN Web environment was easy to work with (Jiang, 1997). That might explain why students' entrance level of computer skills would not influence their perceived learning.

2.2 Multiple regression

In order to find out which variables could best explain the variance in perceived learning, multiple stepwise regression was run. One pair of variables, students' perceived communications with instructor and with fellow students, was dropped off from the multiple regression analysis due to conceptual overlapping with two other variables, students' perceived interactions with instructor and fellow students. The variable, students' computer competency, was not included in the regression because it was not significantly related to the perceived learning. The remaining eight variables were used for multiple stepwise regression to predict students' perceived learning.

Results of the Stepwise Regression showed that four predictors were entered in the equation: 1) online discussions; 2) instructor-student interaction; 3) time spent on course; 4) written assignments (see Table 3. Summary of Multiple Stepwise Regression analysis for variables predicting perceived learning).

Table 3. Summary of Multiple Stepwise Regression analysis for variables predicting perceived learning (N = 287)

Variables in the Equation

Variable	B	SE B	β
Online discussions	.19	.06	.18***
Instructor-student interaction	.32	.04	.41***
Time on course	-.10	.04	-.11*

Written assignments	.16	.06	.13**

Variables not in the Equation

Variable	Beta In	Partial	Min Toler
Evaluation	.10	.11	.73
Student-student interaction	.08	.08	.64
Instructor responses	.06	.06	.69
Learning style	.09	.10	.76

Note: $R^2 = .33$
*** $p < .001$, ** $p < .01$, * $p < .05$

The multiple coefficient between the criterion (perceived learning) and the best linear combination of the four predictors was $R = .58$. It can be said that 33% of the variation in students' perceived learning could be predicted on the basis of the four predictors. An F of 34.60 on four predictors and 275 *df* was significant beyond $p = .05$, and we conclude that we can predict at better than chance levels.

3. Discussion

Results indicated that students valued their interaction with the instructor, their online capable partner. It has the largest regression coefficient, $B = .32$ ($p < .001$) and an increment of .28 (R^2). The significant correlation between students' perception of learning and their perceived interaction with their instructor ($r = .53$, $p < .001$) also indicates the important and indispensable role of the instructor in online environments. The finding is congruent with Vygotsky's concept of the role of interaction with a capable partner in the learning process.

The learning activity, online discussions, has the second most significant regression coefficient $B = .19$ ($p < .001$). The correlation analysis found a significant correlation between students' perceived learning and their perception of the contribution of online discussions ($r = .38$, $p < .001$). It seems that the more students found their participation in online discussions had contributed to their learning, the more learning they perceived to have experienced. This finding is in line with our earlier finding that students' perceived learning was significantly correlated to percent of grade weight assigned to students' participation in discussions (Jiang, 1998; Jiang and Ting, 1998). The implication of this finding is that it is not only important to create an interactive environment for learning, but also important to design discussion activities that will trigger rich and meaningful online discourse.

Written assignments were also found to be a significant contributor to perceived learning ($B = .16$, $p < .01$). This contradicted findings in our earlier studies. It was found that percent of grade weight assigned to written assignments was not significantly related to students' perceived learning. Our argument was that online written assignments were not much different from the traditional classroom written assignments that are common and major learning activities for students in college courses. We believed that that was of the reasons why the percent of grade for written assignments did not significantly influence students' perceived learning. Another reason might be the small sample size ($N = 17$) for that study. In this study which was based on survey data, students perceived written assignments as contributing to their learning nearly equally as they did the discussion activity, though students seemed to value a little bit more the interactive learning activity - online discussions - than the written assignments in this online environment.

Time spent on course has a significant but negative regression coefficient ($B = -.10$, $p < .05$). The correlation analysis also revealed a significant but negative coefficient ($r = -.18$, $p < .01$). These findings seem to contradict our common sense expectation. In a classroom setting, we would normally expect better learning if students spend more time on a course. One possible explanation for the negative coefficients is that these courses were online courses and there were many extraneous factors related to the amount of time spent on a course such as ease of navigation in a course, speed of students' equipment, instructional design of learning activities, clarity of instructions of how to work on learning activities. Since we did not inquire how students had spent their time on a course, it remains a question for future study to find out why time spent on course was negatively related to students' perceived learning.

4. Conclusions

SUNY Learning Network used one single template for all the 78 courses offered in the fall of 1997. This unique feature offered a good opportunity to make inquiries about students' perceptions of their learning in this online environment and to find out factors that were associated with their perceived learning. Since the courses were of different subjects and at different academic levels, a generic measurement of learning achievements was not feasible. Although a survey study like this has limitations in reflecting students' learning achievements, it provides us with some information about how students thought about various learning activities, instructional behaviors and their relations to students' perceived learning. Such information will provide some basis for improving design of future Web-based courses. The findings of the study indicate the importance of an interactive learning environment and the online support from an instructor. Future design of web-based online courses should emphasize the role of online discussions and create an environment to ensure meaningful discourse among students and the instructor.

5. References

Anderson, S.E. (1997). Factors associated with amount of use and benefits obtained by users of a statewide educational telecomputing network. *Educational Technology Research and Development*, Vol. 45, No. 1, pp. 19-50 ISSN 1042-1629.

Berge, Z. L. (1997). Characteristics of online teaching in post-secondary, formal education. *Educational Technology*, May-June, 1997.

Collins, A., Brown, J. S., and Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator*, 15, 6-11, 38-46.

Dillman, D. A. (1978). *Mail and telephone surveys: The total design method.* New York: John Wiley & Sons.

Fabro, K. G. (1996). Computer conferencing in higher education: An exploration of communication and cognitive development issues (distance education). Unpublished MSC dissertation, University of Calgary (Canada). AAC MM18748. ProQuest - Dissertation Abstracts.

Harasim, L. M. (Ed.) (1990). *On-line education: Perspectives on a new environment.* New York, NY: Praeger Publishing.

Hartman, K., Neuwirth, C. M., Kiesler, S., Sproull, L., Cochran, C., Palmquist, M., and Zubrow, D. (1995). Patterns of social interaction and learning to write: Some effects of network technologies. In Z. L. Berge and M. P. Collins (Eds.). *Computer-mediated communication and online classroom. Vol. 2. Higher Education.* Cresskill, NJ: Hampton Press.

Hiltz, S. R. (1990). Evaluating the Virtual Classroom. Chapter 7 in L. M. Harasim (Ed.). *On-line education: Perspectives on a new environment.* New York, NY: Praeger Publishing.

Jiang, M. (1997). The design, development and evaluation of nineteen SUNY Learning Network Web-based courses. The paper was included in the author's Doctoral Portfolio presented to fulfill a partial requirement for a doctoral degree.

Jiang, M. (1998). Distance learning in a web-based environment: An analysis of factors influencing students' perceptions of online learning. (Doctoral dissertation, State University of New York, Albany)

Jiang, M. and Ting, E. (1998). Course design, instruction, and students' online behaviors: A study of instructional variables and students' perceptions of online learning. The paper was presented as a full paper at AERA 98, San Diego.

Kaye, A. R. (Ed.) (1992). *Collaborative learning through computer conferencing.* New York, NY: Springer-Verlag.

Lundgren-Cayrol, K. M. (1996). Computer-conferencing: A collaborative learning environment for distance education students. Unpublished doctoral dissertation, Concordia University (Canada). AAC NN10873. ProQuest - Dissertation Abstracts.

McConnell, D. (1992). Computer mediated communication for management learning. Chapter 4 in A. R. Kaye (Ed.). *Collaborative learning through computer conferencing.* New York, NY: Springer-Verlag.

Simon, C. (1992). Telematic support for in-service teacher training. Chapter 2 in A. R. Kaye (Ed.). *Collaborative learning through computer conferencing.* New York, NY: Springer-Verlag.

Vygotsky, L. S. (1986). *Thought and language.* Cambridge, MA: the MIT press.

6. Appendix

Table 2. Interrelations among variables (N = 287)

	1	2	3	4	5	6	7	8	9
1. Instructor-student communication									
2. Student-student communication	.57***								
3. Online discussion	.40***	.45***							
4. Instructor-student interaction	.66***	.45***	.43***						
5. Student-student interaction	.44***	.67***	.52***	.50***					
6. Instructor responses	.36***	.30***	.50***	.39***	.31***				
7. Perceived learning	.55***	.46***	.38***	.53**8	.36***	.33***			
8. Written assignments	.16**	.04	.14*	.20***	.06	.26***	.24***		
9. Evaluation	.28***	.14*	.26***	.37***	.21***	.38***	.34***	.42***	
10. Time on learning	-.26**	-.17**	-.04	-.14*	-.07	-.07	-.18*	-.05	.42***
11. Learning style	.13*	.15*	-.02	.11	.17**	-.00	.12*	.01	-.04
12. Prior computer competency	.11	.01	.06	.11	.13*	.12*	.03	.03	.13*

Note: * p < .05, ** p < .01, *** p < .001

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Comparative Analysis of Online vs. Face-to-Face Instruction

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Abstract: This empirical study compared a graduate online course with an equivalent course taught in a traditional face-to-face format. Comparisons included student ratings of instructor and course quality; assessment of course interaction, structure, and support; and learning outcomes such as course grades and student self-assessment of their ability to perform various Instructional Systems Design (ISD) tasks. Results revealed that the students in the face-to-face course held slightly more positive perceptions about the instructor and overall course quality although there was no difference between the two course formats in learning outcomes. The findings have direct implications for the development and delivery of online instruction.

1. Introduction

New advances in Internet-based technology have brought challenges and opportunities to education and training, particularly through online instruction. While online instruction is gaining popularity, it is not free from criticism. Many educators and trainers do not support online instruction because they do not believe it actually solves difficult teaching and learning problems (Conlon, 1997). Concerns include the changing nature of technology, the complexity of networked systems, unstable online learning environments, and the limited understanding of how much students and instructors need to know to successfully participate (Brandt, 1996). Online instruction also threatens to commercialize education, isolate students and faculty, reduce standards, and devalue university degrees (Gallick, 1998). While these concerns may be unwarranted, there is little research to fully understand the benefits and pitfalls of online instruction, especially when compared to face-to-face learning environments. Gaining knowledge about the processes and outcomes of online instruction as compared to face-to-face environments will help educators make more informed decisions about future online course development and implementation.

1.1 Problem Statement

Although the popularity of online programs has increased in recent years, the capabilities and efficacy of such programs have yet to be fully investigated. Most effort in this area has been devoted to program development and much of the research has anecdotal in nature. With little empirical knowledge of Internet-based education outcomes, the need for research in this area is not only timely, but also imperative. The primary purpose of this study was to compare an online course with an equivalent course taught in a traditional face-to-face format. Comparisons included student ratings of instructor and course quality; assessment of course interaction, structure, and support; and learning outcomes such as course projects and student self-assessment of their ability to perform various ISD tasks.

1.2 Research Questions

This study was designed to answer the following research questions:

1. What differences exist in satisfaction with the learning experience of students enrolled in online vs. face-to-face learning environments?

2. What differences exist in student perceptions of student/instructor interaction, course structure, and course support between students enrolled in online vs. face-to-face learning environments?
3. What differences exist in the learning outcomes (i.e., perceived content knowledge and quality of course projects) of students enrolled in online vs. face-to-face learning environments?

2. Background

There are many assumptions about Internet-based education, most of which are positive and optimistic (Relan & Gillani, 1997). The many challenges associated with creating meaningful learning environments via the Internet (Hill, 1997) include how to meet the expectations and needs of instructors and students and how to design courses so they provide a satisfying and effective learning environment. From program developer and instructor perspectives, understanding these issues is critical for the development and implementation of quality online instruction.

While few experimental studies have compared the effectiveness of online instruction to the more traditional face-to-face offering, two recent studies provide encouraging results for developers of online instruction. Schutte (1997) conducted a small scale experiment in which he divided a class of 33 students into a traditional section and a virtual section taught on the World Wide Web (WWW). Schutte's results showed that instruction provided online can result in improved performance. LaRose, Gregg, and Eastin (1998) conducted a similar study that compared the learning outcomes of students in a traditional lecture section to course section that provided pre-recorded audio via the WWW along with detailed course outlines and related course pages accessed on the Web. Results showed that the Web group had test scores and student attitude ratings equal to those of the traditional section. While these types of quasi-experimental studies present methodological challenges (e.g., dealing with small sample sizes, the effect of prior knowledge, etc.), they do provide an important first step into better understanding the effect of online instruction on learning outcomes and student satisfaction.

3. Method

3.1 Subjects and Instructional Setting

This study compared outcome data obtained from students enrolled in one of two versions of a graduate level instructional design course for human resource professionals. One version of the course was taught using a traditional face-to-face format while the other version of the same course was offered totally online, with no direct face-to-face contact between the instructor and the students. Both courses were taught by the same instructor using the same content, activities, and projects. Nineteen students, most of whom are pursuing a graduate degree in HRD, were enrolled in the on-campus course. Nineteen students were also enrolled in the online version of the course. These students are also pursuing a graduate degree in HRD through a degree program that is taught completely online.

3.2 Instrumentation

The *Course Interaction, Structure, and Support* (CISS) instrument was used to assess student's perceptions of the quality of various instruction-related variables. This instrument is a hybrid of the *Distance and Open Learning Scale* (DOLES) and the *Dimensions of Distance Education (DDE)* (Harrison, Seeman, Behm, Saba, Molise, & Williams, 1991; Jegede, Fraser, & Curtin, 1995). CISS consists of 11 items for the dialog construct, 8 items for support, 8 items for course structure, and 4 items for transactional distance.

3.3 Procedures

All data were collected at or near the end of the semester. The on-campus students completed paper versions of the instruments while the online students completed equivalent online version of the instruments. All instrument data were entered into a statistical analysis package for later analysis. Statistical analysis was conducted using independent sample *t*-tests with a significance level of .05.

The search for differences in learning outcomes between students enrolled in the online vs. face-to-face learning environments was conducted using two primary sources of data. The quality of a major course project was the first indicator of learning outcomes. Students in both courses were required to complete a training package that included all training materials and instructional aids as well as all student materials needed to conduct the training. A blind review process was used to evaluate the quality of the course projects. Three HRD doctoral students with instructional design experience were asked to independently evaluate each project in terms of the presentation quality, course organization, degree of detail provided, and overall quality. The reviewers were not told that the purpose of the review was to compare the two course formats and they did not know which projects came from online or face-to face sections. The reviewers rated each project on a four-point scale for each of the four quality characteristics. Analysis of variance was used to examine ratings of the projects using a significance level of .05.

A self-assessment instrument was also administered at the end of the course. This instrument asked students to rate their level of comfort at performing various ISD tasks. A total of 29 items were developed from the course objectives. Individual *t*-tests were conducted to examine differences between the groups on each of the task items.

4. Results

The following results are from comparisons of the face-to-face and the online students' perceptions in the areas of satisfaction, course interaction, course structure, and support. Further analysis compares student learning outcomes in terms of course project quality and a self-assessment of their ability to perform various ISD tasks.

4.1 Student Satisfaction

Student satisfaction was assessed using two items on the CISS instrument that corresponded to the global items used by the university to evaluate all campus courses. These items asked students to rate, on a five point Likert scale (5 = exceptionally high rating), the overall quality of the instruction and the course.

Both groups provided positive ratings, although the face-to-face group displayed more positive views than the online group. The instructor's overall teaching effectiveness received a mean rating for the face-to-face group of 4.21 ($SD = .79$) while the online course mean was 3.58 ($SD = 1.07$). A similar, though non-significant, difference was found for the overall course quality rating, with the face-to-face group ($M = 4.32$, $SD = .73$) providing a slightly more positive rating than the online group ($M = 3.79$, $SD = .92$), $t(36) = 1.94$, $p > .05$.

4.2 Perceptions of Course Interaction, Structure, and Support

The CISS instrument assessed student perceptions regarding course interaction, structure, and support throughout the semester. Using a four point Likert scale, the students indicated the degree to which they *Agree* (4) or *Disagree* (1) with various statements. Overall, both groups of students had positive perceptions, with the face-to-face students having significantly more positive views for interaction and support.

4.2.1 Student Interactions

Interaction among the students was assessed using 5 items that represented characteristics of a learning environment that support student communications, shared learning experiences, teamwork, building a sense of community, and promoting an increase in student contacts. As shown in Table 1, there was a significant difference in the between the two course formats, $t(33) = 3.847$, $p < .05$.

Students enrolled in the traditional face-to-face course had a more favorable opinion of the amount and type of interactions among the students. Analysis of the individual items revealed no difference in the amount of contact among the students but a significant difference in terms of communication with other students in the class, sharing learning experiences with other students, perceptions of a sense of community, and being able to work in teams.

4.2.2 Student & Instructor Interactions

There was a difference in the perception of interaction between the instructor and the students as assessed using items covering teaching style, interaction with the instructor, instructor feedback on student progress, and the instructor's treatment of the students. Analysis of the individual items revealed a significant difference relating to students being informed about their progress in the course, student and instructor interactions during the course, and the treatment of the students in the course, with a lower rating by the online students.

CISS Instrument Sections	Face-to-Face*	Online*	*t*
Student Interactions	3.23 (.51)	2.65 (.37)	3.847**
Student & Instructor Interactions	3.11 (.49)	2.74 (.41)	2.455**
Course Structure	3.16 (.41)	2.94 (.40)	1.641
Instructor Support	3.17 (.43)	2.75 (.53)	2.690**
Departmental Support	2.15 (.56)	2.66 (.46)	-2.921**

Note: *Group means determined using a 4 point Likert scale ranging from Strongly Agree (4) to Strongly Disagree (1). Mean value above 2.5 indicates a positive perception among the students. A positive *t* value indicates a more positive perception among the face-to-face students. Standard deviations in parentheses.

**$p < .05$

Table 1: Perceptions of Course Interaction, Structure, and Support.

4.2.3 Course Structure

There was no difference in the variable that examined issues of students being allowed to work at their own pace, quality of the course syllabus, structure of class activities, organization of the content, student input in the topics selection, teaching methods, and student assessment.

4.2.4 Instructor and Departmental Support

Instructor support included comprehensiveness and usefulness of feedback, student encouragement, and the instructor being able to help students identify problem areas with their studies. The students in the face-to-face course rated the instructor significantly higher for instructor support than the online students. Analysis of individual items showed no difference in the amount of encouragement the instructor provided to the students. These differences relate to the characteristics of instructor feedback and the ability of the instructor to assist students to identify weaknesses in their course preparation.

Departmental support included information the department provided to the students, inquiring about their learning needs, and providing a communication link between the students and the instructor. The online students rated the departmental support significantly higher than the students enrolled in the face-to-face course. Analysis of individual items showed no difference in the departmental staff inquiring about the student satisfaction with the services provided and the departmental staff serving as facilitators between the instructor and the students. The differences related to students being informed about the support services, and about their learning support needs.

4.3 Student Learning Outcomes

Although student perceptions are important, the ultimate indicator of course effectiveness is the degree to which students reach the objectives. The following analysis examines differences in the quality of the final course projects and a comparison of the students' self-assessment of their ability to perform each element of the ISD process.

4.3.1 Blind Review of Course Projects

A primary outcome of the instructional design course was the completion of a complete training package that served as evidence that students had gained the knowledge and skills required of instructional designers. Since some of the students choose to work together on this project, the number of projects produced does not match the class enrollments. A blind review process was used to evaluate the quality of the course projects to compare the outcomes across the two course formats.

Overall, the thirty projects were rated very favorably ($M = 3.43$, $SD = .60$). The overall mean rating of the face-to-face class projects was 3.47 ($SD = .60$) and the mean rating for the online class projects was 3.40 ($SD = .61$). The difference in the project ratings for the two groups was not significant.

4.3.2 Self-Assessment

A self-assessment instrument assessed students' reported levels of comfort at performing various instructional design tasks. Each task was rated on a four point scale from Very Comfortable (4) to Very Uncomfortable (1). Significant differences were found on only five of the 29 items on the self-assessment instrument. The online group felt more comfortable than the face-to-face group when distinguishing among various ISD models while the face-to-face group felt more comfortable performing a learner analysis, preparing a content analysis, writing instructional goal statements, and writing terminal objectives in comparison to the online group upon completion of the course.

5. Discussion

As discussed in the opening sections of this paper, the effectiveness of online instruction is unclear. The results of this study show that student satisfaction with their learning experience tends to be slightly more positive for students in a traditional course format although there is no difference in the quality of the learning. These results suggest that online instruction can be as effective as traditional face-to-face instruction.

Students from both groups provided positive ratings of the instruction and the course. Although the face-to-face group provided a slightly more positive rating of instructor quality than the online group, the reasons for this difference are not evident. It is possible that the instructor was more effective in the traditional format, although the lack of difference in the learning outcomes does not support this. Another possible explanation is that student ratings may be higher when there is a personal connection between the instructor and the students, something that may not occur in an online course. Another possibility is that the response set of online students tends to be lower than the response set of students in a traditional format. Clearly, additional study of the influence of online instruction on student ratings is needed.

Generally, the face-to-face students indicated a more positive perspective on the learning environment characteristics than the online students. Considering the fact that the face-to-face class met in person once a week for a 3 hour period throughout the semester, the differences in student interaction levels are to be expected. Students in face-to-face courses can more easily get together for an extended period of time to discuss class projects, work out any differences of opinion, and build social relationships. In contrast, online students do not have similar opportunities, although the technology provides a surrogate form for similar interactions. This suggests that the online environment may lack the strong social dimension that is beneficial to face-to-face classroom experiences.

Differences between the online and face-to-face groups were significant for instructor and departmental support. Students in the face-to-face course reported higher levels of instructor support than did the online students. A more detailed item analysis reflected that the differences stemmed from the characteristics of instructor feedback. This makes sense in view of the differing contexts of the two classes. The face-to-face setting allowed the instructor to vary the nature and type of feedback as needed. In the online course however, the instructor feedback was limited largely to e-mail, fax, uploaded files, and periodic telephone conversations as a means of delivering feedback. The face-to-face students received live and dynamic forms of support from the instructor while the online group received support in a form of one way static communication. In terms of departmental support, the online students reported higher ratings than the face-to-face students. This difference is easily explained by the fact that the face-to-face class had direct contact with the instructor and a part time teaching assistant, therefore they had little need for support from the department. In contrast, given the complexities of online technologies, the online class had more need for technical support, a service that was provided by the department.

The lack of difference in the learning outcomes from the two course formats supports the continued development of online programs. Using a blind review process to judge the quality of the major course projects, the ratings of three independent reviewers showed no difference in the quality of the projects across the two course formats. While there were significant differences on five of the 29 self-assessment items, examination of the results as a whole indicate the students in both groups are equally comfortable in performing the instructional design tasks. Four of the sets of means fell between the "comfortable – very comfortable" range and one set of means fell between the "uncomfortable – comfortable" range. Overall, both groups indicated a level of comfort at performing the tasks. It is worth devoting some discussion as to why these few differences did exist.

5.1 Implications for Future Online Programs

The ultimate question surrounding online instruction is whether or not it is as effective as traditional face-to-face modes. The findings of this study show that online learning can be as effective as face-to-face learning in spite of the fact that students in online programs are less satisfied with their experience than students in more traditional learning environments. In view of these findings, several implications emerge pertaining to future online programs.

First, this analysis suggests that the development and use of online programs should continue. Further examination of feedback and student progress are needed to improve overall student/instructor communication. This includes identifying and implementing new communication measures to facilitate student/instructor communication at appropriate points in the course. Second, a better understanding of why online learners report lower levels of comfort with their learning is needed so specific strategies for improving delivery of online programs that increase student confidence levels can be developed. Finally, educational practitioners who may enroll in or develop online courses need to be familiar with the limitations of online programs. Such an awareness will ensure that the expectations of learners are met and the intended course goals can be attained. For instance, the findings in this study suggest that online instruction may not be suitable for courses that require high degrees of student instructor interaction and feedback, such as performance-based training methods courses that rely on considerable mentoring and coaching. Until the technologies for online instruction better simulate real time interaction, program developers need to avoid courses that require frequent socialization between students and the instructor.

6. References

Brandt, D. S. (1996, February, 27). *Teaching the net: Innovative techniques in Internet training*. Paper presented at the 11th Annual Computers in Business Conference, Washington DC. (ERIC Document No. ED 412 975)

Conlon, T. (1997). The Internet is not a panacea. *Scottish Educational Review, 29*(1), 30-38.

Gallick, S. (1998). *Technology in higher education: Opportunities and threats*. University of California at Los Angeles, Los Angeles, CA. (ERIC Document No. ED 415 929)

Harrison, P. J., Seeman, B. J., Behm, R., Saba, F., Molise, G., & Williams, M. D. (1991). Development of a distance education assessment instrument. *Educational Technology Research & Development, 39*(4), 65-77.

Jegede, O. J., Fraser, B., & Curtin, D. F. (1995). The development and validation of a distance and open learning environment scale. *Educational Technology Research & Development, 43*(1), 90-94.

LaRose, R., Gregg, J., & Eastin, M. (1998). Audiographic telecourses for the Web: An experiment. *Journal of Computer-Mediated Communication, 4*(2). Available: *http://www.ascusc.org/jcmc/vol4/issue2/larose.html*

Relan, A., & Gillani, B. (1997). Web-based instruction and the traditional classroom: Similarities and differences. In B. H. Khan (Ed.). *Web-based instruction*. (pp. 41-47). Englewood Cliffs, NJ: Educational Technology Publications.

Schutte, J. G. (1997). Virtual teaching in higher education: The new intellectual superhighway or just another traffic jam. Available: *http://www.csun.edu/sociology/virexp.htm*

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Student Use of Computer-Mediated Communication in a Distance Education Course

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Abstract: Students enrolled in a graduate level social work class offered through distance education were encouraged to used e-mail and a class listserv. Analysis of the sources and content of course-related electronic transmissions revealed that distant students were significantly more likely than on-campus students to use e-mail and a course listserv. Students used the technology most often for practical reasons, such as asking for clarification of course expectations or requesting exam results. They seldom used the listserv for extended discussions of course content or related topics. In responses to a survey about their use of computer-mediated communication (CMC) they reported significant increases in self-assessed competence, and expressed positive opinions about these technological supports.

1. Background

Distance education, defined as education or training courses delivered to off-campus sites via audio, video, or computer technologies, is being increasingly utilized in institutes of higher learning (The Department of Education, 1997). There were an estimated 753,640 students formally enrolled in distance education courses in the 1994-95 academic year. A third of higher education institutions reported offering some type of distance education courses, and another quarter planned to offer distance education within the next three years.

With an expansion in the use of this teaching modality, educators are searching for ways to reduce students' feelings of isolation by increasing interaction among students, and between students and instructors. Both students and faculty seem to prefer being able to interact directly with each other, and reportedly miss this convenience in distance education classes (Dillion, 1989; Fast, 1995). Studies suggest the value of learner-learner and learner-instructor interactions in distance education settings (McGiven, 1994; Wagner, 1993; Shale & Garrison, 1990). Learner-learner interaction may be the most challenging type of interaction to implement in distance education (Moore,1989). While students in traditional settings can easily interact with their instructor and peers, these same type of interactions must be carefully planned and structured by teachers of distance education (Parker, 1997). The use of computer-mediated communication (CMC), such as electronic mail (e-mail) and a class listserv in distance education courses are two ways to increase student interactions.

Computer-mediated communication has been used as an aid for distance education (Mason & Kaye, 1980; Romiszowki & de Haas, 1989) to foster a sense of community among students, encourage group interaction, and extend discussion beyond class time (Folaron, 1995; Karayan & Crowe, 1997; Latting, 1994), to facilitate or enhance student/instructor contact (D'Souza, 1991, 1992; Latting, 1994), and to simulate a debate (Flynn, 1987). Most instructors report successful experiences, with some notable exceptions (e.g., Latting, 1994). Flynn (1987) suggests that e-mail is particularly beneficial "in a learning environment populated by persons on the move who have a variety of competing commitments. Students today often commute large distances for education and training on a part-time basis or while holding down a full-time job. Traditional methods anchored in the classroom are insufficient" (p. 18). What he is describing, of course, is the typical student enrolled in a distance education class.

Rogers (9281) suggests that the successful diffusion of an innovation throughout a social system begs the question of whether it has desirable effects. He notes that studies of effectiveness are hindered by several factors: most researchers interested in the topic share a pro-innovation bias, that there is a tendency for diffusion research to side with the change agencies that promote innovations rather than with the audience of potential adopters, conventional attitude surveys fail to measure outcomes, and often consequences are confounded with other effects. Sliwa (1994) cautions instructors against the temptation to embrace all available technology without question. Instead, educators are encouraged to accept only those strategies that improve the quality of learning, and to carefully evaluate any technological tools they choose to use in the classroom. The emphasis must remain on effective teaching and learning. In accordance with this, the objectives of this study were to analyze the students' actual use of e-mail and the class listserv.

2. Study Setting and Methodology

The study was conducted in a graduate level social work program in a large public university in the southeastern United States. The study population consisted of 76 first year, part-time students enrolled in a distance education course during the spring 1998 semester. Thirty students attended class in a studio on campus and 46 attended at 12 other sites around the state. Distant students were required to be present on campus only three times: for the course introduction, the midterm exam, and the final exam. All but one of the students had been enrolled in two distance education courses the previous fall. The instructor of one of those courses used a listserv and also assigned "e-mail journal partners" to facilitate interaction between students.

The majority of the students were white (61%) and female (85%). Almost all were part-time students who held full-time jobs. There were no significant differences between the groups with respect to student enrollment status (full or part-time), work schedule (full or part-time), ethnicity, gender, or age.

The course was offered via two-way audio and one-way video instruction. Students at the distant sites could see the instructor on television monitors and could hear her and the students present in the studio. They could call in to the studio with questions and comments via an 800 number. The instructor could not see them.

The instructor used a class listserv to post her lecture outline and study questions every week. Ten percent of the semester grade for the course was based on class attendance and participation. Students could enhance their participation scores either by speaking up during class and/or by sending messages to the class listserv. The instructor offered no guidelines on what constituted an unacceptably low level of participation. The instructor provided students with information on how to reach her by phone as well as by e-mail.

The author was interested in how students used e-mail and the listserv within the context of the class or, specifically, whether there were any differences between the distant and campus students in their use of the class listserv and e-mail in these courses, and for what purposes the students used computer-mediated communication.

The author analyzed all computer-mediated communications related to the course that were sent by the students to the instructor via e-mail or the listserv. (E-mail transmissions exchanged directly between students were not available for analysis.) The texts of the transmissions were downloaded and printed in a single document totaling more than 650 pages. The transmissions were coded by source and sender, and by message content.

3. Findings

3.1 Sources and Senders of Transmissions

Of 369 transmissions generated by students, 274 (74%) came via individual e-mail to the instructor, and 95 (26%) were shared with the instructor and classmates via the listserv. Only 58 (15.7%) of the 369 transmissions came from campus students even though 39% of the students enrolled in the course attended class on campus. This was a statistically significant difference (chi square with 1 df = 86.9, $p < .001$). Seventeen students sent no transmissions at all; 16 of those students attended class on campus. Another 11 students sent only one message each. Of the total 369 student transmissions, 264 (71.5% of the total) were sent by only 10 students, all of whom viewed the class from distant sites.

3.2 Topics

The manifest content of the students' messages was coded into 14 topic categories: logistics (e.g., requests for information about the class meetings, pleas for extensions on due dates), questions about the assignments (e.g., selecting a topic for the term paper), actual assignments (papers) sent via e-mail, requests for individual exam results and grade reports, problems with the listserv, problems with e-mail, comments related to class content, requests to classmates for assistance, sharing of information (about course-related events in the news or outside resources), comments about that outside information, comments regarding the listserv in response to a request for input from the instructor, unsolicited comments and evaluative feedback offered to the course instructor and guest lecturers, and acknowledgment of messages

Topic code	Number and percent of all messages	Number and percent of all e-mail messages	Number and percent of all listserv messages
Class logistics	66 (17.0%)	50 (17.0%)	16 (16.6%)
Questions about assignments	31 (7.9%)	27 (9.2%)	4 (4.2%)
Assignment attached	35 (9.0%)	35 (11.9%)	0 (0.0%)
Requests for grades	79 (20.0%)	79 (27.0%)	0 (0.0%)
Problems with listserv	26 (6.7%)	22 (7.5%)	4 (4.2%)
Problems with e-mail	5 (1.3%)	4 (1.4%)	1 (1.0%)
Comments related to class content	10 (2.6%)	6 (2.0%)	4 (4.2%)
Requests to classmates for assistance	10 (2.6%)	0 (0.0%)	10 (10.4%)
Sharing of outside resources	25 (6.4%)	1 (0.3%)	24 (25.0%)
Comments about outside information	11 (2.8%)	0 (0.0%)	11 (11.5%)
Feedback regarding the listserv	15 (3.9%)	6 (2.0%)	9 (9.4%)
Feedback to the instructor(s)	16 (4.1%)	16 (5.5%)	0 (0.0%)
Acknowledgment of messages received	42 (10.8%)	35 (11.9%)	7 (7.3%)
Duplicate transmissions	17 (4.4%)	12 (4.1%)	5 (5.2%)
Totals*	388	292	96

*There were a total of 369 transmission, but several contained multiple messages, bringing the total number of messages to 388.

Table 1. Topics of student messages, as a percent of all messages, all e-mail messages, and all listserv messages.

or information received, and duplicate transmissions. Because 17 of the transmissions contained two or three clearly distinct topics, the total number of student messages coded was 388, nineteen more than the number of transmissions. Details of the results of the content analysis are shown in the Table 1.

The most common message topic was requests for grades, accounting for 29% of individual e-mail messages and 20% of all messages. The most common topic for the listserv was sharing of outside resources; this category accounted for 25% of listserv messages. Discussion of class logistics was the second most common topic for both the listserv (16.6%) and e-mails (17%). Comments/discussion directly related to class content accounted for only 4.2% of listserv messages and 2.6% of all messages sent. Messages about problems using the listserv accounted for 6.7% of all messages, and messages about problems with e-mail accounted for 1.3%.

4. Discussion and Recommendations

Limitations of the study include the usual restrictions that apply to educational research: 1) the use of a convenience sample in defining the study population; 2) the use of pre-existing, non-equivalent groups without random assignment; and 3) the potential for bias on the part of both respondents and researchers. In addition, the effectiveness of the instructional use of computer-mediated communication may have been limited due to the relative lack of technological expertise and experience on the part of the instructor.

Consistent with the finding of other studies of computer-mediated communication in social work education (e.g., Folaron, 1995; Latting, 1994), problems reported by students included information overload, access problems, a division within the class between the "haves" and the "have-nots," and insurmountable technological challenges. Technology problems and lack of computer accessibility and were the most common negative comments. For example, one student wrote, "It took many tries to get on the listserv and it was inconvenient for me. I don't agree that e-mail should be required. Older students don't all have computers. It causes unnecessary stress and frustration."

Analysis of the sources of course-related electronic transmissions revealed that students attending at distant sites were significantly more likely than were campus students to use e-mail and the class listserv. This finding suggests that this technology is particularly appealing to those students who do not have regular face-to-face contact with their instructor. In other words, it was used to remedy some of the inherent short-comings of distance education rather than to augment learning. Students used the technology most often for practical reasons, such as dealing with logistics, requesting grade reports, or clarifying expectations related to assignments. In a classroom setting these issues might be handled by the instructor before or after class, or during a break. The students seldom used the listserv for extended discussions of course content or related topics; in fact, these purposes comprised less than 6% of all messages sent. At the same time 8% of student-initiated messages were about problems they were experiencing with the technology.

The instructor personally found the listserv helpful in exchanging information (e.g., expectations, lecture outlines, and information about assignments) with students, thus preserving more of the in-class time for instruction and learning. Negative consequences included the high volume of incoming electronic transmissions (including an additional 72 transmissions from "the system" and the university's listserv coordinator related to the course), and time spent trying to help students who had repeated difficulties in using electronic mail or the class listserv. As noted above, not all students had equal access, knowledge, or skills, and there were multiple software and server "glitches" that needed to be addressed. The author found that the availability of competent support staff was crucial to the successful use of these teaching tools.

The vast majority of student comments were very positive. One wrote, "[The listserv] is one of the greatest advantages that distance ed student have. It keeps us informed, allows [us] to assist each other, ask questions, and just to feel as part of the overall class. It may be frustrating at the beginning of the semester getting subscribed and so forth, but it is more than worth the trouble. The good definitely outweighs the bad. " Another said, "I love having access to the listserv and e-mail. It makes communication with you much easier. It also helps to get the outlines before class. I feel I have an advantage over the other two students at my site because they have been unable to access the listserv and do not get all of the pertinent information. I share with them as much as I can! It is interesting to read all of the communication among the other students. I don't have much time to chat with them, but I do enjoy reading their communications." And a third wrote, " I do enjoy having the listserv with all of the benefits of interacting with fellow classmates and the instructor. This service helps those of us at distance ed sites feel like we are a part of the class. There are times when you feel very detached from the larger group in the distance education program. I am so thankful for the listserv." Another concluded, "Thank you for taking the time to communicate with us through listserv. I hope you pass the word around the all of the other professors so they will use it for their classes."

The author recommends that educators employ computer-mediated communication to enhance student/instructor and student to student contact, particularly in distance education courses. Guided practice, along with simple written directions on the use of e-mail and the listserv, should be included in a general orientation session and/or at the first class meeting if at all possible. During the first several weeks of class, extra time and emotional support should be provided to students who experience technological difficulties (see Romiszowski & de Haas, 1989). Facilitating direct contact between students and the listserv coordinator (technician) may free the instructor from time-consuming and nonproductive exchanges regarding the intricacies and frequent technical malfunctions of computer-mediated communication. Instructors should develop specific expectations or course requirements related to CMC if they want students to use e-mail and/or a listserv to supplement other modes of learning.

Given the wide availability and growing familiarity with e-mail and listservs, computer-mediated communication presents an opportunity for effective and efficient contact with distance education students, both individually and as a class group.

5. References

D'Souza, P. V. (1991). The use of electronic mail as an instructional aid: An exploratory study. *Journal of Computer-Based Instruction, 18* (3), 106-110.

D'Souza, P. V. (1992). Electronic mail in academic settings: A multipurpose communication tool. *Educational Technology, 32,* (3) 22-25.

Dillion, C. (1989). Faculty rewards and instructional telecommunications: A view from the telecourse facility. *American Journal of Distance Education, 3*(2), 35-43.

Fast, M. (1995, April). *Interaction in technology: Mediated, multisite, foreign language instruction.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Flynn, J. P. (1987). Simulating policy processes through electronic mail. *Computers in Human Services, 2* (1/2), 13-26.

Folaron, G. (1995). Enhancing learning with e-mail. *Journal of Teaching in Social Work, 12* (1/2), 3-18.

Karayan, S. & Crowe, J. (1997). Student perceptions of electronic discussion groups. *T.H.E. Journal.*

Latting, J. K. (1994). Diffusion of computer-mediated communication in a graduate social work class: Lessons from "the class from hell." *Computers in Human Services, 10* (3), 21-45.

Mason, R. & Kaye, A. (Eds.) (1989). *Mindweave: Communication, computers & distance education.* NY: Pergamon Press.

McGiven, J. (1994). Designing the learning environment to meet the needs of distant students. *Journal of Technology and Learning, 27*(2), 52-57.

National Survey of Distance Education (1997). Available: www.nces.ed.gov/pubs98/ distance/index. html.

Parker, A. (1997). *A distance education how-to manual: Recommendations from the field.* [On-line]. Available: www.webcom.com/ journal/parker.html.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd edition). New York: The Free Press.

Romiszowki, A. J. & de Haas, J. A. (1989). Computer-mediated communication for instruction: Using e-mail as a seminar. *Educational Technology, 29,* (10), 7-14.

Shale, D., & Garrison, R. (1990). Education and communication. In R. Garrison & D. Shale (Eds.), *Education at a distance* (pp. 23-39). Malabar, Florida: Krieger Publishing Company.

Sliwa, S. (1994). Re-engineering the learning process with information technology. *Academe, 80,* 8-12.

Wagner, E. (1993). Variables affecting distance educational program success. *Educational Technology, 33,* (4), 28-32.

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The case for patterns in online learning

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Abstract: The current practice of online learning, especially at an institutional level, can be characterised as being complex and expensive with limited sharing of ideas and experience leading to a large amount of reinvention. Patterns, simple and elegant explanations which capture solutions that have developed and evolved over time, are abstractions being used to increase reuse and quality in a variety of fields including architecture, software engineering, hypermedia, and teaching/learning. This paper will introduce the concept of patterns, suggest that they offer advantages for online learning and describe how they are being used at Central Queensland University.

Introduction

Central Queensland University (CQU) is a multi-campus regional institution with four branch, three interstate, and several international campuses. Fifty percent of CQU's students learn using a primarily print-based distance education approach. As with many other institutions CQU is increasing its use of online learning technologies for a variety of reasons both good and bad. In making widespread use of online learning CQU faces the same problems as other institutions. This paper describes what these problems are and suggests a process for the development and use of patterns in online learning as a possible step towards addressing these problems. In doing so the paper describes patterns and how they are being used at CQU.

The problems

The perceived need for the development and use of patterns for online learning (or possibly even traditional teaching and learning) is being driven by the observation of a number of problems with existing practice in online learning. These problems include

- **The innovator/practitioner gap.** Every year the literature includes hundreds, if not thousands, of good ideas associated with online learning. Most of these ideas are due to the work of a small group of innovators and researchers at individual institutions. At some institutions these ideas may come out of established centres for the support of and research into teaching and learning while at others they are the work of lone-ranging innovators. Few if any of these ideas find widespread use within their home institution and even less find widespread adoption amongst other institutions. Collis and Oliver (1999) report in their analysis of the papers submitted to EdMedia'99 that the majority of papers report on prototype development and evaluation with few ideas going beyond this stage. Additionally there is a long history of failed technology-based innovations (Reeves, 1999). There is a gap between the research and innovation in teaching and learning and the everyday practice.
- **The field gap.** The design and development of online learning requires input from professionals in a number of fields including computing, graphic design, instructional design and instructors. One of the problems with such group development activities is the limited understanding and appreciation of the disparate fields involved in the process. The gap in understanding and respect between the professionals of different fields can reduce the quality of the outcomes.
- **Online learning is new.** The new medium is different from traditional forms of teaching and learning, face-to-face and print-based distance education. It has different requirements and needs new methods to make most effective use of it. However, many if not most, applications of online learning continue to reuse methods and approaches from more traditional forms of teaching and learning. A contributing factor to this is that people are not aware of what can be done with the new medium and are falling back on what they know.
- **The relative unimportance of teaching.** Most Universities continue to be research focused with little but lip service being paid to the importance of teaching and learning. Evaluation of teaching and learning and

subsequent rewards for innovative and effective practices is limited. Subsequently it is no surprise when teaching staff pay little heed to adopting new approaches to teaching and learning.

- **Inflexible support systems.** A combination of these factors along with the complexity of online learning leads to the development of large support structures and procedures to support and implement online learning. Most of these structures and procedures, like those associated with institutionalised print-based distance education, are inflexible and cannot adapt to changes in the environment or to the requirements of individual courses, staff or students.
- **Limited quality.** All these factors contribute to most online learning being limited in quality. Surveys of websites for teaching and learning (LaRose &Whitten, 1999; Mioduser, Nachmias, Oren & Lahav, 1999) show that the majority of sites make less than effective use of the medium.

Requirements for a Solution

The overall aim of a solution to these problems is to increase the quality of online learning at an institution. To achieve this it is suggested that such a solution will have to

- **Reuse expertise and experience.** It should capture and enable the reuse of the expertise of researchers made available in the literature and of the current practice of the innovators at an institution. It should enable, improve and reward the continued innovation of the innovators.
- **Provide training and raise awareness.** Provide a forum where people from all the fields involved in the development and implementation of online teaching and learning can discuss ideas, learn about the new medium and become aware of the requirements of each field.
- **Encourage reflection and evaluation.** An essential component of any solution should be to encourage people to reflect and evaluate the quality of teaching and learning and reward people for participation in the process.
- **Provide an adaptable, appropriate support system.** The characteristics of online mean that a support system will be required. However, the support system should be able to adapt to changes in technology and to the individual requirements of courses, staff and students.

A possible solution is to provide a common language which enables collaboration and sharing of ideas. The provision of a common language facilitates the process of understanding and may decrease the amount of reinvention. If everyone involved is speaking the same language it facilitates the process of understanding. However, providing a common language is not enough. An environment which emphasises the discovery, collaboration and reflection in which to use this language is also required. We suggest that 'patterns' and their appropriate application may be one possible answer.

History of patterns

Christopher Alexander appears to have first proposed the idea of patterns for application in the field of architecture in the late 60s early 70s. In the late 80s early 90s programmers struggling with object oriented programming discovered the concept of design patterns and adopted them for use in designing object-oriented programming systems. The use of patterns has since exploded into a wide range of different fields including: pedagogy (Erickson & Leidig 1997; Manns, Sharp, Prieto, & McLaughlin 1998); analysis (Fernandez 1998); hypermedia (Nanard, Nanard & Kahn, 1998; Rossi, Garrido & Carvalho 1996); structuring organisations; re-engineering systems; project planning; and a range of other different areas.

What is a pattern

A pattern is "a generic approach to solving a particular problem that can be tailored to specific cases. Properly used, they can save time and improve quality" (Fernandez 1998). As Alexander (1977) puts it: "Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice". At a simple level, a pattern is a way to record the knowledge and experience of experts. A way of reusing best practice and taking into account the lessons others have already learned.

The use of patterns provide a number of benefits including making it easier to reuse successful designs, make proven techniques more accessible to developers, enable choice between alternatives, and improve the documentation and maintenance of existing systems (Gamma, Helm, Johnson and Vlissides, 1994).

In practice, a particular pattern format is used to describe the decisions, alternatives and the trade-offs which contributed to the development of the pattern. The use of consistent format for the description of patterns makes it easier to learn, compare and use patterns (Gamma, Helm, Johnson and Vlissides, 1994). There are a number of common formats which have been used to describe patterns in different applications.

Writing a pattern

Writing a pattern is a difficult, creative, and usually collaborative process. A major contributor to the difficulty of writing a pattern is extracting and abstracting expert knowledge and experience from a situation. Additionally, actually achieving the qualities of a well written pattern can be extremely difficult. The process usually starts with pattern mining, that is, searching for patterns to document. This could be undertaken by searching the literature, attending conferences, or reflecting upon personal practice to abstract practices which work. The pattern author is not necessarily the original innovator, although that can be the case.

Patterns are usually developed in a writers workshop, a practice adapted from creative writing. Writers workshops are a collaborative way of producing and improving upon patterns. A writers workshop is a positive, friendly and collaborative group process led by a moderator with the author actively participating at designated times. In short, the group forms a circle, reads the pattern, offers positive comments then suggestions for improvement, finally the author asks for clarification.

At some point in the future the author rewrites the pattern based on the feedback from the writers workshop. Once a pattern has been identified, written and moved through a writers workshop it is then stored in a pattern catalogue. A pattern catalogue is a collection of good patterns.

Typically, at least in programming and a number of other fields, conferences are held where writers workshops are conducted. Pattern Languages of Programming (PLoP) design conferences are one of the key areas where programming design patterns are produced. There is non-anonymous review and careful editing. PLoP conferences are held around the world annually EuroPLoP (http://www.argo.be/europlop), PLoP USA (http://st-www.cs.uiuc.edu/~plop/plop99/), Chilli PloP (http://www.agcs.com/patterns/chilliplop). Additionally, at regular intervals PLoP conferences produce edited books of the best patterns from conferences (Coplien and Schmidt 1995; Vlissides, Coplien & Kerth, 1996).

The mystical aspects of patterns

It could be argued that patterns and pattern workshops are basically a collaborative process for producing a number of papers which follow a fixed format. Patterns, particularly when they are grouped together in a pattern language (described below), are intended to be much more. Three of the aspects of patterns which make it more than a specially formatted paper are: generativity, piecemeal growth, and the quality without a name (QWAN).

Generativity

Patterns are not simply descriptions of good systems, they are meant to generate new systems. When a pattern is applied the system moves from one particular context to a new context. Ideally, by the continual applications of related and well designed patterns a living structure is generated capable of dynamically adapting to changing needs and demands. Using an analogy from architecture, patterns are designed so that rather than building only a single room, it can be added to and generate a new environment which can be adapted to different means. The intent is that as a number of small patterns are applied, the well designed pattern language will move the user to a larger solution addressing larger problems.

Piecemeal growth

Piecemeal growth is the assumption that every environment whether it be for a building, a learning environment or a computer program is continually changing. Piecemeal growth is the opposite of traditional practice, particularly in architecture, which relies on design for replacement. For example a building is created with one purpose in mind. Twenty years later when there are more people it is torn down and replaced with a different building which better suits the current context.

Piecemeal growth is an approach which emphasises design for repair, not replacement. As the environment changes new patterns are selected and applied continually moving the design from one context to another, replacing older designs with more appropriate designs. An example of this is the story about the most beautiful house in the world (Rybczynski 1990). Rybczynski, a professor of architecture, sets out to build a dwelling in which to house the construction of a boat. However, as building proceeds the environment changes and the purpose of the dwelling changes. Eventually, rather than using it to build a boat the structure becomes a place to live. This is an example of piecemeal growth, continually applying patterns to achieve something that you probably would not have predicted in the beginning.

Quality without a name (QWAN)

The QWAN of a pattern is the incommunicable beauty that gives immeasurable value to the structure. Again using the architecture analogy QWAN is that experience of walking into a room that is well designed and just 'feels' right. The quality is without a name because it is meant to include concepts such as beauty and order, recursive centres of symmetry and balance, life and wholeness, resilience, adaptability, durability, comfort, satisfaction, and resonance (emotionally and cognitively). These concepts form QWAN as described by Alexander (1979) for architecture. QWAN for online learning may include some of these qualities but may also require more specialised qualities.

QWAN is one of the three foundation concepts for the pattern based approach to architecture proposed by Alexander (1979). The other two foundation concepts are "the gate" and "the timeless way". In summary, "the gate' (a pattern language, described below) provides the path by which you can use "the timeless way" (piecemeal growth)' to achieve QWAN.

Pattern languages

A pattern language is more than just a pattern catalogue (a collection of patterns). It is a cohesive collection of patterns and rules (guidance) on how to combine these patterns into a style or philosophy that enables you to achieve the QWAN. A pattern language is not meant to be a simple to follow prescription or recipe. Instead it is a language which enables an infinite variety of solutions limited only by the creativity and ability of the user of the pattern language. A good pattern language guides the designer toward useful or 'good' architectures (Coplien 1996).

Theories, Golden Rules, Patterns and Templates

Nanard, Nanard and Kahn (1998) talk about the relationship between golden rules, patterns and constructive templates in relation to using design patterns in hypermedia. In designing a hypermedia application there are collections of patterns that can be used which have been influenced by the golden rules. For example short term memory effectively holds seven plus or minus two entities, this is a golden rule in interface design. Therefore when interfaces are designed they should only have seven plus or minus two choices on screen.

Constructive templates are approaches or ways in which patterns could be implemented. Remember patterns are meant to be abstract whereas constructive templates are more descriptive enabling patterns to be put into practice. Typically a pattern may be related to numerous constructive templates due to the variability of a good pattern.

The authors would like to expand the Nanard, Nanard and Kahn (1998) model to include a higher principle relating to the education field, that is the philosophical stance that the educator brings to the entire experience. This is the set of beliefs the educator has about how teaching and learning occur, for example the constructivist philosophy. It is suggested that the beliefs an educator has will inform the golden rules which in turn inform the patterns that are implemented using the constructive templates.

The demise of experts

A misconception that arises when discussing the application of patterns is the possible demise of experts. If there is a pattern catalogue available to novices which describes how to design a good system, surely the experts will no longer be necessary? The reason this may not occur is that applying patterns requires a great deal of knowledge and creativity. To create and apply patterns in online learning a knowledge of the context of application is required in addition to a familiarity with the environment and the implications of actions. For example a knowledge about the students' situation and the content is essential.

There also needs to be an understanding of patterns and creativity in their application and combination. The application of one pattern will not solve all problems, by their very essence they are meant to encapsulate one issue. Further, continually creating patterns requires a community of experts contributing to and evaluating patterns. Therefore patterns are not a way to eradicate professionals, rather they "channel creativity; they neither replace nor constrain it" (Coplien 1996). Importantly, once experts start using pattern languages they are not straight-jacketed into a regime. Patterns and pattern languages are designed such that there is enough variability that they can be applied creatively in an infinite number of ways.

Patterns, online learning and current work

We are currently setting up a patterns group at CQU which hopes to develop a pattern catalogue for online learning. It is hoped that the pattern catalogue and the process used to construct it will develop into an approach for implementing and evaluating online learning which will address the problems outlined earlier. The process we are using includes the following steps

- **Pattern Mining.** This includes sifting through the existing literature and also practice at CQU for examples of good practice. Pattern mining helps bridge the gap between research and practice. By mining the literature we are finally attempting to put into practice many of the good ideas which have been discussed in recent years.
- **Pattern Workshops.** Over a period of six months individuals from a number of fields including: instructional design, graphic design, web masters and instructors will come together in a number of pattern workshops. Each person will be responsible for creating patterns from the results of the pattern mining process. The collaborative, group development process which makes up a patterns workshop will provide an opportunity to share knowledge, experience and ideas amongst a varied group of staff. Participation in this process is a form of professional development and will help expand the participant's awareness of the ideas of other areas and their understanding of online learning.
- **Pattern Catalogue.** The patterns which are produced by the patterns workshops will be placed into a Web-based pattern catalogue which offers a number of different ways of searching for patterns. Being able to easily search and view patterns may make it easier for other staff to identify good practice applicable in their situation. Additionally, the patterns produced by this process will be published in a book which will contribute publications which count towards promotion and provides extra incentive to the workshop participants.
- **Constructive templates** (Nanard, Nanard & Kahn, 1998). To increase the ease by which these patterns can be adopted by other staff a number of the patterns will be implemented as constructive templates into a web development tool currently used by the Faculty of Informatics and Communication (Jones, 1999).

In the longer term it is hoped that pattern mining and construction can become an entrenched part of the teaching and learning practice at Central Queensland University.

Conclusion

Patterns are a basis for codifying and using innovation. Creating patterns requires a collaborative process which emphasises the continual reflection and generation of new patterns based on experience. We are suggesting that the incorporation of a pattern generation process into standard practice will address many of the problems associated with online learning. Eventually, when a pattern language for online learning has been produced, it may be possible to generate an online learning experience which demonstrates the quality without a name.

References

Alexander, C., Ishikawa, S., Silverstein, M. (1977) *A Pattern Language: Towns, Buildings, Construction.* Oxford University Press.

Alexander, C. (1979) *The Timeless Way of Building.* Oxford University Press.

Collis, B., Oliver, R. (1999) Preface. *Proceedings of EdMedia'99*, Seattle, Washington, pp 5-6.

Coplien, J. (1996) Software Design Patterns: Common Questions and Answers. ftp://st.cs.uiuc.edu/pub/patterns/papers/PatQandA.ps

Coplien, J., Schmidt, D. (1995) *Pattern Languages of Program Design* Addison Wesley, Reading, Massachusetts.

Erickson, C., Leidig, P. (1997) A pedagogical pattern for bringing service into the curriculum via the web. *ACM SIGCSE Bulletin*, Vol. 29, No. 3, pp 54-56

Fernandez, E.B. (1998) Building systems using analysis patterns. *Proceedings of the Third International Workshop on Software Architecture*, pp 37-40.

Gamma, E., Helm, R., Johnson, R., Vlissides, J. (1994) *Design Patterns: Elements of Reusable Object-Oriented Software* Addison Wesley, Reading, Massachusetts.

Jones, D. (1999) Webfuse: An Integrated, Eclectic Web Authoring Tool. to appear *Proceedings of EdMedia'99*

LaRose, R., Whitten, P. (1999) Building Web Courses with Instructional Immediacy. *Proceedings of EdMedia'99*, Seattle, Washington, pp 1436-1437.

Manns, M.L., Sharp, H., Prieto, M., McLaughlin, P. (1998) Capturing Successful Practices in OT Education and Training. *Journal of Object Oriented Programming* Vol. 11, No. 1, pp 29-34.

Mioduser, D., Nachmias, R., Oren, A., Lahav, O. (1999) Web-Based Learning Environments (WBLE): Current State and Emerging Trends. *Proceedings of EdMedia'99*, Seattle, Washington, pp 753-758

Nanard, M., Nanard, J., Kahn, P. (1998) Pushing reuse in hypermedia design: golden rules, design patterns and constructive templates. *Proceedings of the 9th ACM Conference on Hypertext and Hypermedia* pp 11-20.

Reeves, T. (1999) A Research Agenda for Interactive Learning in the New Millennium. *Proceedings of EdMedia'99*, Seattle, Washington, pp 15-20.

Rybczynski, W. (1990) *Most Beautiful House in the World.* Viking Press

Vlissides, J., Coplien, J., Kerth, N. (1996) *Pattern Languages of Program Design 2.* Addison Wesley, Reading, Massachusetts.

A Reference Model for the Design of I-NET Applications

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Abstract: This paper presents a reference model for the design of Intranets. The reference model is part of a detailed project model called PROMET I-NET, which logically and timely structures the implementation of Intranets. In designing an Intranet we distinguish between an Intranet as a whole (macro level) and its constituting I-NET applications (micro level). The project model covers all phases of an I-NET project starting from requirements analysis to the implementation of a system not only on a technical level but on a strategic and organizational level as well. It doesn't replace existing methodologies but embraces them in its framework.

1. Introduction

In the last couple of years the implementation of Intranets proved to be an efficient and economical means to integrate distributed and heterogeneous data sources. I-NET applications became very popular because of the ease of implementation, too. However, there is a lack of systematic approaches for the realization of I-NET solutions. In general, existing techniques and procedures are based on results of research work within the areas of hypermedia, database design and software engineering (e.g. HDM [Garzotto et al. 1993], OOHDM [Schwabe & Rossi 1995], RMM [Isakowitz et al. 1995], W3DT [Bichler & Nusser 1996]). These works usually concentrate on isolated, mostly technology-oriented questions. So far a comprehensive approach which also includes organizational aspects and project planning in the conception phase of I-NET applications is missing.

This paper presents a reference model for the design of Intranets. It is part of the project model PROMET I-NET, which logically and timely structures the implementation of Intranets. The project model covers all phases of an I-NET project starting from requirements analysis to the implementation of a system not only on a technical level but on a strategic and organizational level as well. The goal is not to replace existing methodologies but to integrate and embrace them into this I-NET specific approach.

Both, the reference model and the project model were developed in the context of a research project in cooperation with leading German and Swiss enterprises where it has been validated in several projects.

2. Fundamental principles of I-NET applications

2.1. Terms and Definitions

I-NET technology describes a group of software and hardware components which implement protocols (e.g. TCP/IP, HTTP), naming conventions (e.g. URL, DNS), languages (e.g. HTML) and interfaces (e.g. CGI), that were originally developed for communication purposes and for the exchange of information on the Internet [Kaiser et al. 1996]

An *I-NET application* is a client/server-application which consists of at least one I-NET client and one I-NET server communicating over a standardized TCP/IP application protocol (e.g. HTTP, FTP, NNTP, ...). A client/server-application using a proprietary protocol on the application layer (e.g. SAPGUI with SAP R/3 or Lotus Notes Client with Lotus Notes) is not considered as an I-NET application, even if it is TCP/IP-based.

In this paper web applications are of special interest. *Web applications* are I-NET applications which communicate via HTTP. The corresponding client and server components are usually referred to as *web browser* or *web server*. The reason for their importance is that they provide interfaces (e.g. HTML, Java API, CGI) which can be used for the development of business applications.

2.2. I-NET Architecture

An *architecture* is a formal description of a system. It serves as a plan for the implementation of a system and offers a base of discussion when developing its structure during the conception phase. An architecture consists of several components (building blocks) which interact with each other. The *components* of an architecture provide a set of functions, which can be used over well-defined interfaces. The implementation of components in software can be done in different ways and to various extent.

The I-NET architecture of an enterprise can be described on different levels, which differ in extent and level of detail. The *macro level* describes the whole I-NET as an infrastructure consisting of network, hardware, software, middleware and application components. The description covers all regarded organizational units and locations of the business (enterprise-wide architecture). The *micro level* describes the architecture of an individual I-NET application and its interfaces to other applications and data sources (I-NET and non-I-NET applications). It concentrates on an I-NET application's components and their interaction (application-specific architecture).

3. I-NET Reference Architecture

3.1. Macro Level

On the macro level the structure of a physical I-NET can be described from three different points of view: a technical, an applicational and an organizational view.

3.1.1. *Technical View*

The *technical view* describes individual I-NET components and their respective relationships on a technical level. It focuses on platform components (e.g. clients, server), their functionality (e.g. productive, staging or backup system), their LAN- and WAN-connections and their middleware and hardware services. The goal is to show the relationship between components, especially connections between public networks and corporate networks as well as security issues. [Fig. 1] gives an example of the technical view on an I-NET architecture.

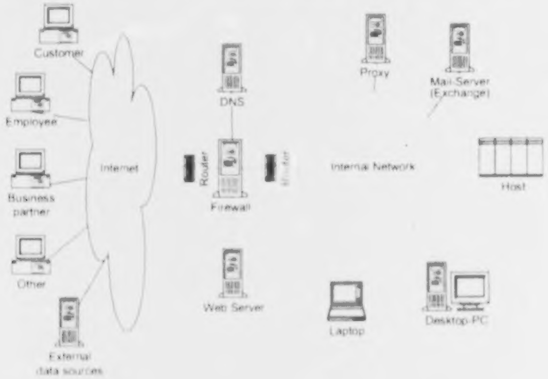

Figure 1: Technical view on an I-NET architecture

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3.1.2. Applicational View

The *applicational view* describes the applications and data sources of an I-NET and their relationships. Each data source has a relation to an application which is responsible for its data. It also shows how applications exchange data with each other over interfaces as well as components shared between applications. This view concentrates on web applications in particular. Applications which are developed with ordinary technology are only considered if there is an integrational relationship to a web application. [Fig. 2] shows an example for this view.

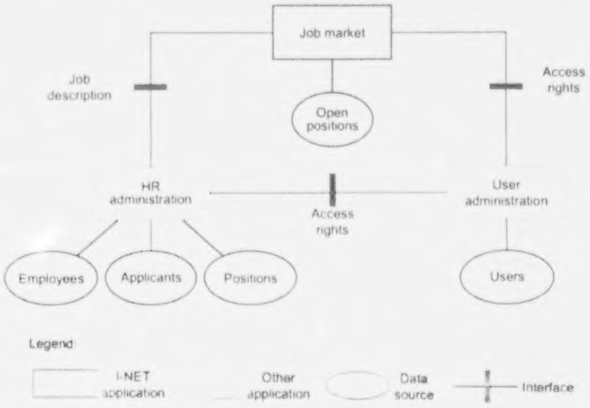
Job market
Job description
Open positions
Access rights
HR administration
Access rights
User administration
Employees
Applicants
Positions
Users
Legend:
I-NET application
Other application
Data source
Interface

Figure 2: Applicational view of an I-NET architecture

3.1.3. Organizational View

The *organizational view* describes an enterprise's organizational units and locations conncected to the I-NET. Neither I-NET components nor applications nor data and their distribution are considered here. Only the relationships between organizational units and locations of an enterprise's I-NET are relevant. The view can be illustrated as an organizational chart as shown in [Fig. 3].

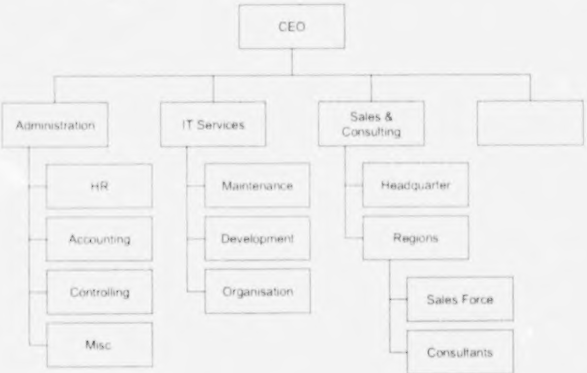
CEO
Administration
IT Services
Sales & Consulting
HR
Accounting
Controlling
Misc
Maintenance
Development
Organisation
Headquarter
Regions
Sales Force
Consultants

Figure 3: Organizational view of an I-NET architecture

The following diagram shows the I-NET reference architecture on the macro level. It consists of those I-NET components which are used in the specific organizational units and locations. Moreover, the diagram includes the

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relationship of the organizational units to the outside world. Therefore, the reference architecture on the macro level serves as a model which supports the planning of an enterprise's I-NET. In the diagram the terms *I-NET client* and *I-NET server* are used for different types of client/server components such as a web client, mail client, etc. or respectively a web server, mail server, etc. The term *gateway* describes a set of components facilitating the transition between two subnets. Within such a gateway, functions as encryption, filtering or caching can be implemented [see Fig. 4].

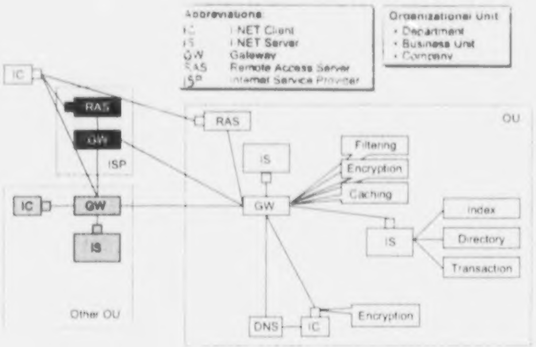
Abbreviations:
IC I-NET Client
IS I-NET Server
GW Gateway
RAS Remote Access Server
ISP Internet Service Provider
Organizational Unit
• Department
• Business Unit
• Company
IC
RAS
GW
ISP
IC
GW
IS
Other OU
RAS
OU
IS
Filtering
Encryption
Caching
GW
IS
Index
Directory
Transaction
Encryption
DNS
IC

Figure 4: I-NET reference architecture (macro level)

3.2. Micro Level

When designing an I-NET application, there is an I-NET-specific part (surrounded by a dark gray box in [Fig. 5]) and a conventional part which can be worked out using classical methods like OOAD. Therefore, we focus only on the I-NET-specific part. This basically contains the application-relevant business processes and, from the physical point of view, all application parts to be implemented on the web client and the web server. Logically, this is the presentation layer (i.e. the graphical user interface and its components) and the part of the application layer to be implemented on the web client (e.g. Java applets). The rest of the application layer and the data layer are not within the scope of our model because they may be considered as external systems in terms of I-NET technology.

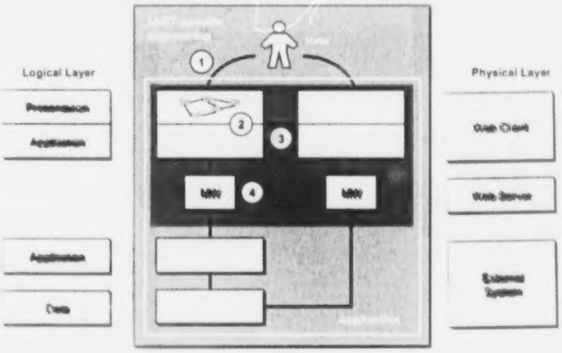
Logical Layer
Presentation
Application
Application
Data
①
②
③
④
MW
MW
Physical Layer
Web Client
Web Server
External System

Figure 5: I-NET reference architecture (micro level)

First of all, interactions between users and the system are considered (1). Then we define structures for the graphical user interface in order to identify GUI components (2). Note that functionality to be implemented on the client is covered in the GUI components as well. Interactions between GUI components are given by the static and dynamic navigation structure (3). The actual interface between I-NET-specific and non-I-NET-specific parts are so-called *services* which are part of the middleware components (esp. a web server) (4).

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4. PROMET I-NET

Any I-NET project requires a methodical approach, starting off with an analysis on potential advantages of I-NET technology for the enterprise, over process analysis to the final implementation of a solution on a technical and organizational level. PROMET I-NET is a project model covering all phases of an I-NET project. It is based on the principles of Method Engineering [Gutzwiller 1994].

The method's procedure model consists of both an enterprise-wide part and a business process-specific part. The enterprise-wide part includes the specification of an I-NET strategy, I-NET architecture as well as structures for operation and maintenance of the I-NET. The business process-specific part focuses on individual I-NET applications, each one supporting one or more business processes with information and knowledge. It is based on the enterprise-wide specifications. Usually both parts are realized as separate projects.

PROMET I-NET divides any project in the four phases project setup, analysis, design and implementation each of which including several activities. In parallel to these other project and change management activities have to be carried out. As these phases are not I-NET specific, they are not considered in our project model. Of course, the overall structure of the procedure model does not differ from traditional projects, however, it is the activities within each phase, which are specific to the use of I-NET technology.

[Figure 6] shows PROMET I-NET's procedure model in a simplified form. Light gray boxes represent major project activities. For each box PROMET I-NET provides a step-by-step technique describing how to develop a solution adequate to the enterprise's requirements. The activities are shown in a temporal and logical sequence and matched with the project phases. Activities that concern enterprise-wide questions are drawn on the left side, business process-specific activities on the right side. Arrows depict logical relationships and dependencies.

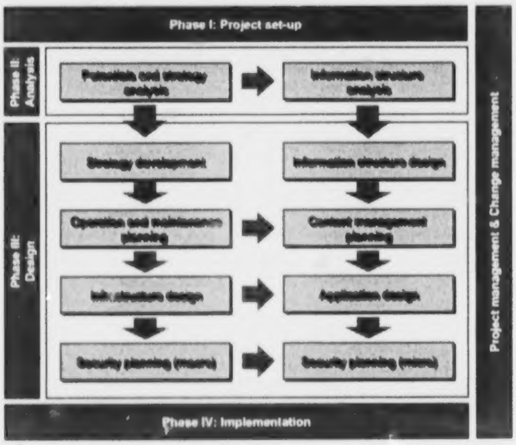
Phase I: Project set-up
Phase II: Analysis
Potentials and strategy analysis
Information structure analysis
Phase III: Design
Strategy development
Information structure design
Operation and maintenance planning
Content management planning
Infr. structure design
Application design
Security planning (macro)
Security planning (micro)
Phase IV: Implementation
Project management & Change management

Figure 6: PROMET I-NET model

Below we describe the activities in more detail.

- *Potentials and strategy analysis*
  The first step in developing an I-NET is the identification of application areas within the enterprise. This requires an analysis of business and IT strategies, current business processes and technology capabilities.
- *Strategy development*
  After identifying application areas existing strategies, standards and policies within the enterprise must be reviewed and revised for reflecting the properties of I-NET technology. This includes security rules, design standards, legal issues, etc.
- *Operation and maintenance planning*
  Like traditional IS an I-NET and its applications require technical services. However, there are some I-NET specific tasks (e.g. access rights, usage control, security audits), which usually are under central control. In this step suitable procedures for these tasks are planned.
- *Infrastructure design*
  Infrastructure design summarizes all technical design activities relevant to the enterprise as a whole (e.g. web

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browsers, web servers, search engines, etc.). It is based on the I-NET reference architecture [see Macro Level]. The main steps are the design of logical and physical structures and derivation of a list of components that have to be added, replaced or removed by comparing the current and future architecture.

- *Security planning (macro)*
  Due to its importance there are separate activities to analyze possible security risks and threats. Based on a detailed assessment a set of required measures (e.g. firewalls, network segmentation, cryptography standards) is defined and the infrastructure is adjusted to prevent security problems.
- *Information structure analysis*
  Before starting with the design of an I-NET application, a business processes' information needs has to be analyzed (unless already done in earlier projects). This includes analysis of process activities, organizational structures, information structures, information flows, and identification of current deficits.
- *Information structure design*
  In this step the future information architecture is being designed. Required information objects and meta-information objects are specified, improved information flows between business processes are designed, conceptual data models, and navigation structures for the planned I-NET application are derived.
- *Content management planning*
  It is crucial for the success of an I-NET application to provide for content management in advance. Processes for creation, distribution, maintenance and removal of content must be defined and linked with a set of suitable roles (author, editor, content manager, etc.).
- *Application design*
  In this activity the actual application is being designed. It is based on the I-NET reference architecture [see Micro Level]. The main steps are the specification of user interfaces, application functionality and middleware services as well as integration links to existing systems and applications.
- *Security planning (micro)*
  While security planning (macro) specified security measures that affect the enterprise-wide I-NET infrastructure, security planning (micro) deals with application-specific security issues (e.g. access rights).

For a detailed case study of the project model's application at LGT Bank in Liechtenstein see [Kaiser et al. 1998].

5. Summary

Planning and implementation of I-NETs require a certain methodology covering all project stages. Our methodology PROMET I-NET is based on a reference model which describes the components of an I-NET application and their interactions in a typical ideal architecture. The model covers both the enterprise-wide I-NET infrastructure (macro level) and the architecture of a single application (micro level). Based on these models we described an iterative procedure to design an I-NET. The procedure model is not just restricted to the technical solution realization, it also considers the organizational context in the enterprise processes.

6. References

Bichler, M. & Nusser, S. (1996). Developing Structured WWW-Sites with W3DT. *1996 World Conference on the WWW and Internet (WebNet 96)*, October 15-19, 1996, San Francisco, CA, USA.

Garzotto, F., Paolini, P. & Schwabe, D. (1993). HDM - A Model-Based Approach to Hypertext Application Design. *ACM Transactions on Information Systems, 11*(1), 1-26.

Gutzwiller, T. A. (1994). *Das CC RIM-Referenzmodell für den Entwurf von betrieblichen, transaktionsorientierten Informationssystemen*. Heidelberg: Physica.

Isakowitz, T., Stohr, E. A. & Balasubramanian, P. (1995). RMM: A Methodology for Structured Hypermedia Design. *Communications of the ACM, 38*(8), 34-44.

Kaiser, T. M., Beck, D. & Österle, H. (1998). *I-NET Enabled Customer Focus - The Case of LGT Bank in Liechtenstein*, St. Gallen: Institute for Information Management, University of St. Gallen.

Kaiser, T. M., Vogler, P. & Österle, H. (1996). Middleware der Zukunft: Internet- und Intranet-Technologien. In H. Österle, R. Riehm & P. Vogler (Eds.), *Middleware - Grundlagen, Produkte und Anwendungsbeispiele für die Integration heterogener Welten*. Braunschweig/Wiesbaden: Vieweg. 137-164.

Schwabe, D. & Rossi, G. (1995). The Object-Oriented Hypermedia Design Model. *Communications of the ACM, 38*(8), 45-46.

Searching the Web Using Synonyms and Senses

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Abstract: The exponential growth of documents on the WWW has made it difficult to find information on the WWW by browsing hypertext documents. Various search engines and indexing techniques have been developed to overcome this difficulty. This paper describes *SynSeek*, a meta-search engine. *SynSeek* demonstrates the effectiveness of interactive boolean query enhancement using senses and synonyms derived from a static manually generated semantic thesaurus WordNet in searching the Web. Interactive boolean query expansion is used so users can easily express or enhance their query. The meta-search engine provides for better coverage of the Internet, so users do not have to try and retry their queries across different search engines. Filtering options are also provided so the user can filter the returned results.

1. Introduction

The exponential growth of documents on the WWW has made it difficult to find information on the WWW by browsing hypertext documents. Various search engines and indexing techniques have been developed to overcome this difficulty. However, anybody who has done some serious search for information using existing search engines knows how frustrating and time consuming the search can get. A primary reason for the poor results is the simplistic approaches that most search engines today employ to satisfy user queries. WWW search engines (like Yahoo, WebCrawler, InfoSeek, etc.) maintain an indexed database of a subset of all web pages on the Internet. Different search engines use different indexing and web page classification techniques to categorize their subset of web page information.

When a user queries the search engine, this index is used to create a list of web documents containing matching words or phrases. Considering the mammoth size of the web and the inherent ambiguity (presence of homographs i.e. words that have the same spelling but different meanings) and vastness of the English Language, a simple text search may not yield satisfactory results. Unless a query is well defined, search engines cannot do much about the quality of results. Once the result set is determined, ranking algorithms frequently rely on quantitative approaches (like term frequency) to rank a document. If the result set is poor, ranking cannot help.

The focus of our study is the keyword based boolean query approach that relies mostly on full text indices. This boolean query approach is unfortunately error prone because of the breadth (different words with the same meaning) and ambiguity (the use of the same word(s) in different senses based on the context) of the English language. This problem is compounded by the fact that the average searcher is lazy. Searchers seldom think of alternative terms for improving their query and usually only use one or two terms for defining their query (last year's average was 1.5 words (Lusk, 1997)).

We present here *SynSeek*, sense/synonym based interactive boolean query enhancement meta-search engine. *SynSeek* uses WordNet, a manually constructed general purpose thesaurus from the Department of Cognitive Science, Princeton University, and the services of three Internet search engines: AltaVista, InfoSeek, and WebCrawler.

In *SynSeek*, the problem of expression and enhancement is alleviated using WordNet. Senses or synonyms of keywords from WordNet are presented to the user, so he can easily add terms to his query by simply checking an HTML checkbox associated with a synonym. The options provided allow the user to either specialize the query to return more specific results, or add additional terms to broaden the scope of the query. The searcher knows the best what he is looking for. Once the sense or ambiguity problem is eliminated, synonyms or other terms that describe that sense provide an excellent source for query enhancement. The underlying assumption is that there is a high probability that documents closest to the true sense of the search will contain some or all of the terms or synonyms that describe that sense.

Section 2 looks at related work done in the areas of the semantic database WordNet. Section 3 describes *SynSeek* from the user's perspective. Sample snapshots of *SynSeek*'s user interface, and an example is used to describe the features of *SynSeek*. Section 4 is a performance evaluation of *SynSeek*. Section 5 concludes that *SynSeek* meets its goal of providing the searcher a more effective and easier way of searching the Web. Ideas for further work for improving *SynSeek* are also discussed.

2. Previous Work

This section discusses related work done in the areas of the semantic database WordNet. WordNet is an English language semantic database developed by the Cognitive Science Laboratory at Princeton University [http://www.cogsci.princeton.edu/~wn/]. WordNet has been used in various information retrieval and natural language processing projects (for a comprehensive list of WordNet related projects, please refer to http://www.cis.upenn.edu/~josephr/wn-biblio.html), a few of them related to the Internet.

Chakravarthy and Haase (1995) have used WordNet and an on-line Webster's dictionary for finding information archives on the Internet using natural language queries. Their program 'NetSerf' focuses on using semantic knowledge to match queries against a list of available generalized descriptions of information archives. Compared to SMART (a standard information retrieval system), on a test set of 75 queries, NetSerf showed an improvement of 28.3% to 70% depending on the number of hits considered. However NetSerf, does not involve any interactive query enhancement approach and does not query Internet search engines.

Burke, et. al. (1997) uses semantic (WordNet) and statistical techniques for matching natural language queries against questions and answers in FAQ files. They showed that a combination of semantic and statistical techniques works better than any single approach. However, this again, does not involve any interactive query enhancement approach and does not query Internet search engines.

3. SynSeek: User's Perspective

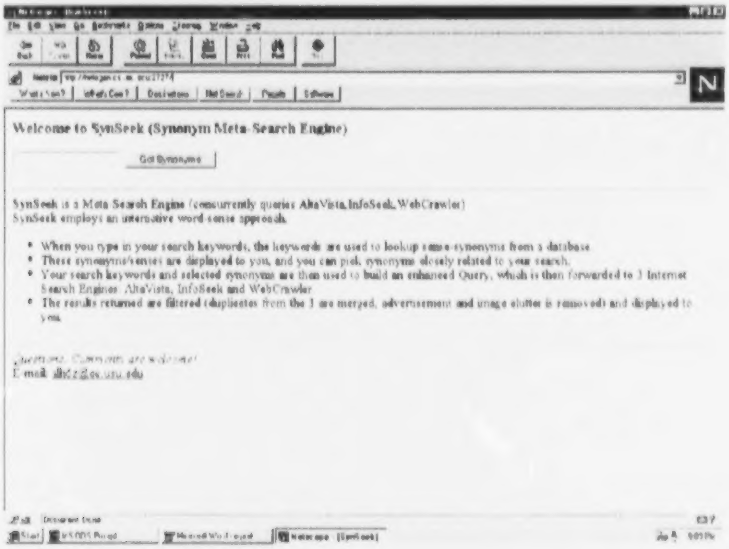
SynSeek's welcome page gives a brief description of how *SynSeek* works and has a text box where the user can type in his search keywords and submit them to the server for senses and synonyms. Figure 1 shows the welcome page.

On receiving the sense and synonym request, SynSeek looks up senses and synonyms for the requested keyword from WordNet, and sends back a dynamically generated HTML form (Figure 2) containing the senses and synonyms of the keyword.

Synonyms are associated with senses, namely each sense has a list of synonyms. The sense and synonym page provides the user the option of adding terms to his query by simply checking the check-box adjacent to each synonym. The user has three ways for adding terms to his query:

1. "Match All Words" is equivalent to the boolean operator 'AND'. This is suitable for narrowing the scope of a query and also making it more specific to particular sense. For example, if a user is searching for information on the island of Java, picking the 'island' sense with the "Match All Words" will construct a query (+Java +Island) i.e. (Java AND Island) restricting the result set to documents that contain both the keywords: Java and Island.
2. "Match Any Word" is equivalent to the boolean operator 'OR'. This is suitable for broadening the scope of a query and also making it more general. For example, if a user is searching for information on the 'United States of America', he would usually also be interested in documents that contain 'USA', 'U.S.A.', 'United States', 'US', 'U.S.', 'America'. Using "Match Any Word" will yield a query "United States of America", OR "USA", OR "U.S.A.", OR "United States of America", OR "USA", OR "U.S.A"....... The user can easily try different combinations of synonyms by simply clicking on the 'Back' button of his browser and checking or un-checking synonyms.

3. The third option is explicitly excluding senses or synonyms from the search query, and is equivalent to the boolean operator 'NOT'. This is suitable for further narrowing down the scope of the query and making it even more specific. The user searching for information on the island of Java can further restrict his query by checking the "object oriented programming language" sense of the keyword java in the "Exclude from Search" section. This will add -"object oriented programming language" to the query i.e. NOT "object oriented programming language".



Welcome to SynSeek (Synonym Meta-Search Engine)

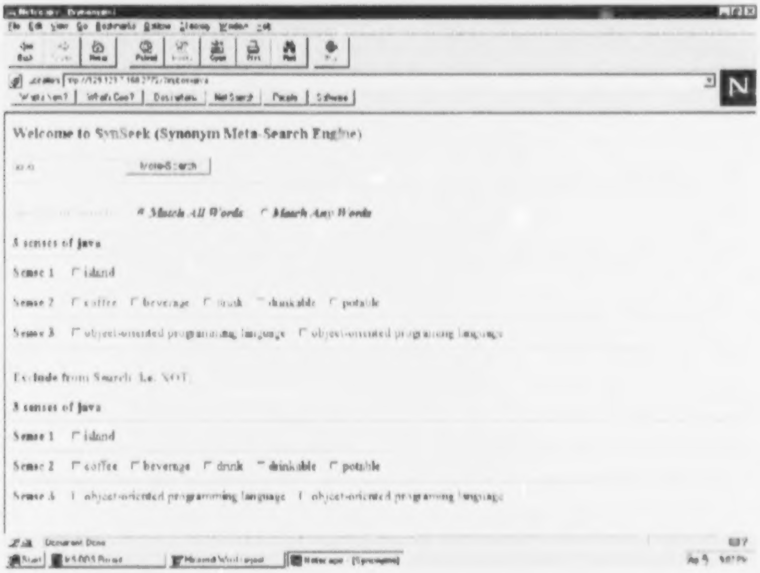
Get Synonyms

SynSeek is a Meta Search Engine (concurrently queries AltaVista,InfoSeek,WebCrawler)
SynSeek employs an interactive word-sense approach.

- When you type in your search keywords, the keywords are used to lookup sense-synonyms from a database.
- These synonyms/senses are displayed to you, and you can pick synonyms closely related to your search.
- Your search keywords and selected synonyms are then used to build an enhanced Query, which is then forwarded to 3 Internet Search Engines: AltaVista, InfoSeek and WebCrawler.
- The results returned are filtered (duplicates from the 3 are merged, advertisement and image clutter is removed) and displayed to you.

Questions, Comments are welcome!
E-mail: [illegible]

Figure 1. SynSeek's Welcome Page



Welcome to SynSeek (Synonym Meta-Search Engine)

java Meta-Search

● *Match All Words* ○ *Match Any Words*

3 senses of java

Sense 1 ☐ island

Sense 2 ☐ coffee ☐ beverage ☐ drink ☐ drinkable ☐ potable

Sense 3 ☐ object-oriented programming language ☐ object-oriented programming language

Exclude from Search (i.e. NOT)

3 senses of java

Sense 1 ☐ island

Sense 2 ☐ coffee ☐ beverage ☐ drink ☐ drinkable ☐ potable

Sense 3 ☐ object-oriented programming language ☐ object-oriented programming language

Figure 2. Senses and Synonyms returned by WordNet for the keyword "java"

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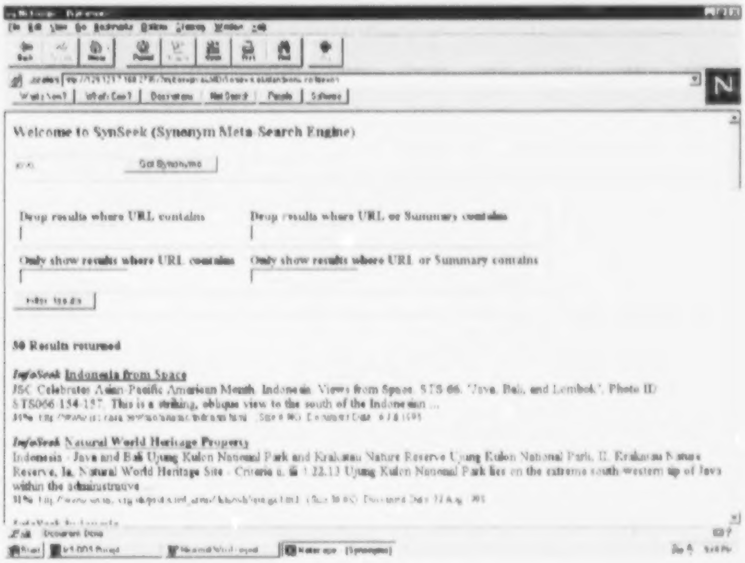
SynSeek builds an enhanced query from the terms picked by the user, and concurrently submits them to three search engines: AltaVista, InfoSeek and WebCrawler. The results returned by each of these three search engines are filtered. Filtering consists of:

1. Removing advertisement and image clutter
2. Merging duplicates (if any) from the three search engines and promoting their ranking for the simple reason that multiple search engines returning the same result is a strong indication that the result is a good.

A fresh page (Figure 3) with the filtered search results is dynamically generated and sent back to the client.



Welcome to SynSeek (Synonym Meta Search Engine)

Drop results where URL contains

Drop results where URL or Summary contains

Only show results where URL contains

Only show results where URL or Summary contains

30 Results returned

InfoSeek Indonesia from Space

JSC Celebrates Asian-Pacific American Month. Indonesia. Views from Space. STS 66. "Java, Bali, and Lombok". Photo ID STS066-154-157. This is a striking, oblique view to the south of the Indonesian ...

InfoSeek Natural World Heritage Property

Indonesia - Java and Bali Ujung Kulon National Park and Krakatau Nature Reserve Ujung Kulon National Park. II. Krakatau Nature Reserve. Ia. Natural World Heritage Site - Criteria ii, iii 1.22.13 Ujung Kulon National Park lies on the extreme south western tip of Java within the administrative ...

Figure 3. Results returned from a search query

The optional filter process can filter results based on user requests for the presence and/or absence of specific keywords in the URL and/or the summary of the result. *SynSeek* gives the user this very desirable ability to filter results. The user can do things like perform a search on a keyword, and then view or drop results from sites that contain that keyword. For example, if a user wants information about Microsoft from sources other than Microsoft Corporation, there is no way of expressing that in the form of a query. With *SynSeek*, the user can submit a keyword search on Microsoft and then submit a filter request to drop results with URLs containing 'microsoft.com'. This will yield a filtered list of results from sites other 'microsoft.com'. The user has four options for filtering results:

- Drop results where the URL contains
- Drop results where the URL or Summary contains
- Only show results where the URL contains
- Only show results where the URL or Summary contains

4. Effectiveness in Web Searching

Query results from three different Internet search engines (AltaVista, InfoSeek and WebCrawler) were compared to the results returned by the same search engines when using *SynSeek*. Both boolean query scope expansion and boolean query scope reduction techniques were tested.

A survey involving searchers of various levels of expertise was conducted. The results of the survey have been favorable: most users found *SynSeek* helpful and easy to use. Searchers who did not find synonyms for their keywords commented that the database should be expanded to be more effective.

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Table 1 shows the summary results from a total of 110 participants:

Survey Question	Result Value	Result %
Experience with On-line Searching:	16.57 months	
Experience with Library System:	2.24/ 5.0	(44.8%)
Experience with Search Engines:	3.65/ 5.0	(73%)
Used Boolean Operators:	45	(40.9%)
Experience with Boolean Operators:	2.09/ 5.0	(41.8%)
Had to go back and change query:	103	(93.6%)
How often was query changed:	3.19/ 5.0	(63.8%)
Tried Multiple Search Engines:	91	(82.72%)
How Often were multiple engines tried:	2.72/ 5.0	(54.4%)
Did SynSeek Find any synonyms:	103	(93.6%)
How helpful were the synonyms:	3.92/ 5.0	(78.4%)
Did you use any of the Synonyms:	83	(75.4%)
Was it hard(1) or easy(5) to improve query using Synonyms:	4.03/ 5.0	(80.6%)
Only tried "Match All Words":	66	(60%)
Only tried "Match Any Word":	0	
Tried Both "Match All Words" and "Match Any Word":	44	(40%)
Tried going back and changing synonym choice:	57	(51.8%)
Used Both "Match All Words" and "Match Any Word", and tried changing Synonyms:	29	(26.3%)
Used the Result Filtering:	58	(52.7%)
How helpful was Filtering:	4.0/ 5.0	(80%)
Found Senses Synonyms more Helpful:	17	(15.4%)
Found Meta-Searching more Helpful:	21	(19%)
Found both Synonyms and Meta-Searching Helpful:	72	(65.4%)
Overall Effectiveness of SynSeek:	4.3/ 5.0	(86%)

Table 1: Summary of Survey Results

While only 40.9% of the participants had used boolean operators before using *SynSeek*, 75.4% of them used the synonyms displayed by *SynSeek* and therefore indirectly used boolean operators.

While 93.6% of the participants said that they had to go back and change their query with other search engines, only 51.8% tried it with *SynSeek*. An improved quality of results on the first try was perhaps one of the reasons for the drop. This is further supported by the fact that *SynSeek* was rated to be much more effective than other search engines. Participants liked both the term suggestions and the meta-searching features and found it quite easy to extend their query based on the term suggestions.

5. Summary

5.1 Summary and Conclusions

This paper explains the motivation behind the design and implementation of *SynSeek*: an Interactive Boolean Query Enhancement Meta-Search Engine for the Internet. Details of the design and implementation are provided, and results of performance testing and a user survey are also provided.

The results show that *SynSeek* meets its goal of providing the searcher an effective and easy to use program for searching the Internet.

5.2 Improvements and Further Work

SynSeek is a good first stab at alleviating the problems faced by Internet searchers. There is a lot that can be done to make *SynSeek* more effective:

1. Dynamically update the Thesaurus, and improve it based on user feedback.
2. To overcome the limitation of single keyword thesaurus lookups, NLP (Natural Language Processing) could be used to detect or improve the quality of terms suggested for user feedback (provided there is adequate context for it).
3. By using an applet the result filtering can be performed on the clients machine rather than the server. This could speed up filtering at the cost of restricting access to *SynSeek* to Java enabled browsers.

6. References

Burke, R. D., Hammond, K. J., Kulyukin, V., Lytinen S. L., Tomuro N., & Schoenberg, S., (1997). "Question Answering from Frequently Asked Question Files," *AI Magazine* 18(2), 57-66.

Chakravarthy, A. S. & Haase K., B., (1995). "NetSerf: Using Semantic Knowledge to Find Internet Information Archives," *SIGIR'95*.

Lusk M., (1997) "Real World Searching Panel at SIGIR'97", *SIGIR'97*.

Enhancing 'Traditional' Classes with Advanced Web-Based Courses

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Abstract: This paper reports our current and on-going R&D efforts towards the design and development of advanced web-based courses, which are used in parallel to existing classes offered by our institution, aiming at enhancing their effectiveness. We outline the instructional design methodologies that have been adopted and the software tools that have been utilised. We discuss issues related to the functionality and the user interface of the courses, as well as their adaptations for meeting diverse student requirements.

1. Introduction and Background

The rapid evolution of information and telecommunication technologies (IT&T) offers numerous new opportunities for the improvement of the educational process. The adoption and exploitation of the emerging IT&T applications and services, and in particular web and internet technologies, is expected to have significant impact on the quality of education and life-long learning offered to the citizens of the information society.

In this context, our institution has recently initiated an R&D effort towards the development of web-based courses which aims at enhancing existing classes. This paper reports on the web-based courses that have been designed and developed in the subjects of Data Bases and Decision Support Systems. The courses are currently used in parallel with "traditional" classes; however, it is also planned that they will evolve into "self-contained" educational material, which will be used explicitly for distance learning.

The paper begins by outlining the design methodologies and software tools that have been utilised. Subsequently, the functionality and the user interface of the courses are addressed, which may have significant impact on the effectiveness of the courses on the educational process. Specific emphasis is given to the range of adaptations supported by the current version of the courses, as well as the ones that are planned for the near future, in order to meet the diverse requirements of different student and instructor groups. The paper concludes with some thoughts concerning our future work in this field.

2. General Design and Development Issues

The design of the courses under discussion has been realised by a multi-disciplinary group, which includes experts from the domains of educational technology, human-computer interaction, web and internet technologies, etc. A student-centred approach has been adopted, i.e. the courses are designed so that the student is actively involved in the educational process, rather than being passively receiving information.

The development lifecycle has followed the waterfall model of software development, where continuous evaluation with students and instructors of our institution has provided significant feedback during all the phases of design and development. For example, the screen layouts and the functionality provided at each stage of the courses have been evaluated by students and instructors, mainly through paper mock-ups and early software prototypes.

The design and development of the courses has been mainly based on, and influenced by, the results of the Instructional Management Systems project (www.imsproject.org). In particular, the requirements, specifications and meta-data specifications produced by the IMS project have formed the basis of our design and development decisions concerning several aspects of the courses, including content quality, functionality, navigational support, etc; as well as implementational issues, such as openness, interoperability, etc.

The software tools that have been mainly used include the Allen Communications' Designer's Edge (www.allencomm.com/software/designer) for the design of the courses; as well as the University of British Columbia's WebCT (homebrew.cs.ubc.ca/webct) for the implementation of the courses. The use of these tools has proven to significantly assist the design and development process, and has enabled the development group to incorporate their expertise into these processes.

The layout used and the functionality provided at each section of the courses has been based on a set of "templates", which have been designed according to common "patterns" found in similar educational applications. In particular, a survey of existing computer-based courses has been conducted, with emphasis on the types of screen layout and functionality provided for the presentation of specific information / content types [Karagiannidis & Tarabanis 1999a]. A respective set of "rules of thumb" has been devised, which are being continuously evaluated by students and instructors of our institution, and has formed the basis for the design of the courses.

It should be also noted that the design of the courses has put specific emphasis so that the educational material is available in different media (i.e. being "media-independent"). This has been considered important, so that the courses are not bound to specific student abilities, machine configurations, etc. For example, the courses are designed so that the whole material can be presented in pure text, which can be used, for example, by blind students utilising text-based browsers, or by sighted students utilising a slow network connection, or a slow machine (see also section on adaptability below).

3. Functionality and User Interface

Specific emphasis has been given on the functionality of the courses, particularly for assisting the user in navigating in the hypermedia information space of the courses. Part of this functionality has been directly provided by the development tools utilised (e.g. chat, e-mail and bulletin board facilities provided by WebCT), while other parts have been programmed by the development team. Examples include:

- graph-like maps of the educational material, where specific paths are suggested according to the student's expertise, background, interests, etc (see also section on adaptability below);
- bookmarking and annotation functions for every educational section;
- history functions, where, for example, the path followed by the student is presented as a graph, in order to provide ;
- specific functions for students (e.g. present all the quizzes of a specific section) and instructors (e.g. statistics concerning the success factor of each quiz, the average scores for each student);
- simultaneous multimedia presentations of the same educational material; for example, the material that is presented through audio, can also be shown in parallel through a scrolling text field, so as to assist the student if the quality of the audio is not acceptable;
- different types of questions, in addition to the ones that are provided by WebCT, e.g. questions where the student is required to insert the missing words into sentences; etc.

Moreover, the courses provide extended functionality for assisting the educational process, such as different course structures and levels of help according to the user's expertise, continuous feedback concerning both the educational process itself (i.e. the educational subject), as well as the user's interaction with the system, etc (see also section on adaptations below).

Central to the design of the courses has also been the requirement for easy access and high quality of interaction, so as to enable the student and instructor focus on the educational process itself, without spending much time on learning the use of the system. To this end, specific emphasis has been given to the user interface of the courses, which follows the general user interface design and development guidelines and recommendations. In particular, after the requirements analysis phase, the design and development of the courses has concentrated on the satisfaction of specific usability requirements, such as the provision of continuous feedback and special help facilities. Finally, specific emphasis has been given on the careful selection of media for presenting information, interaction techniques and objects, input/output devices, etc.

4. Adaptability and Tailorability [1]

In addition to the above, and in order to meet the requirements of different student groups, special care has been given so that the courses provide adaptability and tailorability features. In the current version of the courses the user/student can specify whether she considers herself to be an expert, or novice in the educational subject, and in computer-based courses, in general. According to this selection, the courses are adapted at different levels, and in particular:

- specific sections of the educational material are presented, while other ones are omitted, resulting into two different courses, an "introductory" and an "advanced" one; the material presented to the student, the respective quizzes and their time limits, etc. are adapted accordingly;
- the help provided at each stage, both for the educational material, and for the user interface, is adapted accordingly; "novice students/users" are provided with more extensive details than "expert students/users";
- specific "paths", i.e. course structures are suggested, according to the student's abilities, background, interests, etc.

Additionally, the user (i.e. student or instructor) can specify the machine capabilities (i.e. slow or fast machine) and the connection bandwidth, so that the courses can be adapted accordingly; for example, in the case of a slow internet connection, or a slow machine, the presentation is adapted so that animation and video files are not downloaded, and the presentation is text-based. Alternatively, the student can specify through the "preferences" function that a text-based presentation is preferred, independently from the network connection or the machine capabilities.

These parameters are explicitly specified by the user upon initiation of each "educational session", through a respective dialogue box. Alternatively, they can be inserted to the system through the "preferences" function. It should also be noted that, for the cases that the student does not specify any set of parameters, there is a "default" set which is used for the selection of the appropriate adaptations.

5. Adaptivity [2]

For each student interacting with the system a log file is created, containing information at the "interaction level", and at the "educational level". In particular, log files contain:

- "low-level" lexical information, concerning the student's interaction with the objects comprising the user interface, such as push buttons, fill-in forms, etc;
- as well as information at a "higher-level", such as the sections that have been visited by the student, the quizzes taken and the respective results, etc.

In the current version of the courses, these log files are provided to the instructor as a form of additional information concerning the progress of each student. Also, they are used by the system, in order to provide some adaptive features, such as:

- inform the student that the same sections has been visited many times, and suggest subsequent paths in the educational hyperspace;

---

[1] It should be noted that, in the context of this paper, adaptability refers to the automatic (i.e. system-initiated) selection / modification of selected aspects of the courses, which are based on parameters / characteristics that are considered to remain unmodified during the same "educational session", such as the user's abilities, the terminal type, etc. Tailorability, on the other hand, refers to the student-initiated modification of selected aspects of the courses, through "preferences" function.

[2] Similarly, in the context of this paper, adaptivity refers to the automatic (i.e. system-initiated) selection / modification of selected aspects of the courses, which are based on parameters / characteristics that are considered to be continuously modified during the same educational session, such as the student's familiarity with the educational subject, or with the user interface of the system, etc. The state of these parameters is determined by an "assessment process", which extracts this information through monitoring of the student's interaction with the system [Karagiannidis et al 1998].

- suggest further sources of information, when the student visits the same educational section several times;
- provide extensive help on a specific educational topic, if the rate of correct answers to the respective quizzes falls below a specified threshold; etc.

It is planned that future versions of the courses will also use this information at run-time, in order to extract high-level conclusions concerning the student's progress with respect to the educational subject (e.g. the student has understood a particular section, while she is not familiar with another one), as well as the student's familiarity with the functionality and the user interface of the system (e.g. the user cannot initiate a specific function, or the user is not familiar with web-based applications). Subsequently, it is planned that this information will be used for the selection of run-time adaptations (adaptivity), aiming at enhancing the effectiveness of the educational process, as well as the usability of the user interface.

6. Conclusions and Future Work

This paper has reported on our R&D efforts towards the design and development of advanced web-based courses which aim at assisting existing classes offered by our institution. It has outlined the design methodologies and software tools that have been utilised, and discussed issues relating to the functionality and user interface of the courses. The paper has also presented our current work for the provision of adaptability, tailorability and adaptivity features.

Our current and future R&D work in this field involves the development of methodologies, techniques and tools for the construction of *personalised* web-based courses which can be automatically adapted to the individual characteristics of diverse student and instructor groups; to this end, we investigate the automatic, run-time assessment of the educational process, through the monitoring information contained in the log files created by the courses, and the design of respective run-time adaptations, which aim to assist the educational process; as well as the development of evaluation techniques for adaptive web-based courses, with respect to their effectiveness in the educational process, and their costs.

Also, our current work involves the design, development and evaluation of new multi-metaphor environments for web-based open and distance learning, which enable the full exploitation of the new opportunities provided by the emerging information society applications and services.

7. References

[Karagiannidis & Tarabanis 1999a] Karagiannidis, C., & Tarabanis, K. (1999). Design Patterns and Templates for Tele-Education Applications, *Internal Technical Report, Department of Business Administration, University of Macedonia*.

[Karagiannidis & Tarabanis 1999b] Karagiannidis, C., & Tarabanis, K. (1999). Introducing Computer-Based Learning into Existing 'Traditional' Classes, *16th International Conference on Technology and Education*, Edinburgh, U.K.

[Karagiannidis et al. 1998] Karagiannidis, C., Koumpis, A., Stephanidis, C., & Georgiou A.C. (1998). Employing Queuing Modelling in Intelligent Multimedia User Interfaces, *International Journal of Human-Computer Interaction*, 10(4).

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Dynamic User Interfaces with Java

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Abstract: While developing a distributed infrastructure for personal agents we want to give all kinds of agents a possibility to communicate with their user by means of a central and consistent user interface integrated in their web browser. New agents should be able to join this infrastructure in a dynamic manner without need to change the framework and there should be no built-in restrictions to the complexity of the user interface. We describe a special user communication agent that allows agents to describe their user interface dynamically, display the user interfaces for any number of agents in a special applet and handle remote event delegation. The result is a new kind of ultra-thin client where the web browser and Java Applet merely works as a generic display server.

Introduction

Our research group is currently studying different aspects of software agent systems in a project called CIA [Kargl et.al. 99]. We are developing an infrastructure into which software agents can easily be integrated. In our project all agents belonging to one user form a so called Agent Cluster. This cluster supports the agents with all kinds of commonly needed services like different communication models, persistent storage capabilities, security services etc. The agents are able to communicate via a software bus system called Agent Bus which we implemented on top of the iBus system [Softwired 1999].

For interaction between users and agents we identified a number of possible mechanism:

- Each agent has a local user-interface. The major disadvantage of this solution is that a user always has to be at the computer the agent is running on if he wants to interact with it.
- Each agent has a specific control applet. Now a user is able to control each agent from within his Web Browser. However there is no integration of the different agent user interfaces. If a user wants to control many agents at once he has a lot of windows on his desktop. Interaction between the different agent UIs is difficult as well.
- There's a central control application for all agents that is accessible via an applet. This approach can be found e.g. with most current network administration systems. Agents collect data on all the managed hosts and transmit it to a central management application. The user can attach to this single application using an applet or a standalone user-interface application. This approach works only if you have similar agents running on many hosts. However if your agents are very heterogeneous and new agents with new capabilities and new user interfaces will occur on a regular base, the central control application has to be adapted each time.

- There's a generic display application or applet that is independent of the agent's user interfaces. The agents use the display application to display their user interface and relay user input back.

We have chosen the last approach as we wanted to avoid the disadvantages of the other approaches. It is realized in the User Communication Agent (UCA). This agent handles display of the graphical user interface (GUI) integrated into the web browser, user authentication and many things more. On the other hand, the UCA has no knowledge of the specific details of the different agents in the cluster.

Within an Agent Cluster there is an always changing number of different agents. Each of these agents has different demands regarding its GUI. Some agents may want to display only a simple status message or a text list and have no user interaction whereas others need the user interface of a full scale application with different windows, menus, interactive elements etc. The user interfaces of different agents shouldn't interfere inadvertently. If explicitly needed communication between different components of different user interfaces should be possible. There is a common part in the user interface that's independent of single agents. Functions like listing all active agents, connecting/disconnecting from the Agent Cluster, user authentication etc. fall in this category. This functionality should be realized directly in the UCA without need to reimplement it for each agent.

General Design

The UCA is partitioned into a generic Java Applet that runs in the user's web browser and a server module that connects to the Agent Bus and handles communication with other agents. [Figure 1] shows the principal architecture of the whole system. The details will be explained throughout this text.

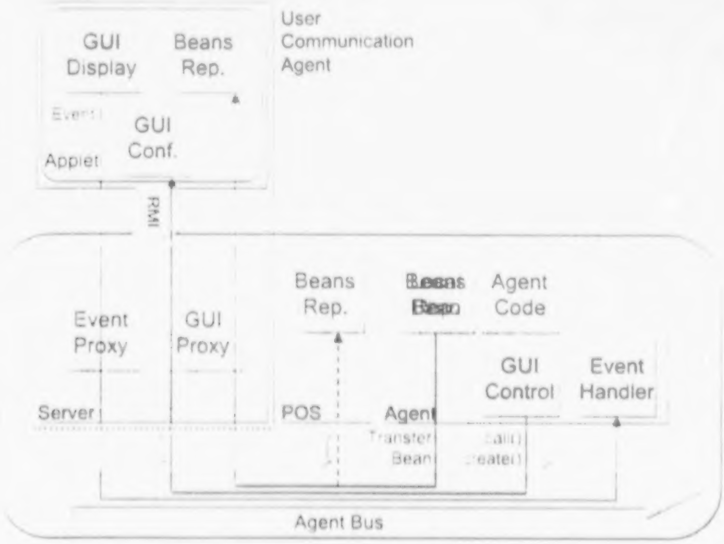

Figure 1: System Architecture

For maximum flexibility we modeled our system in accordance to a modified distributed Display-Control-Model (DCM) design pattern [Buschmann et.al. 1996]. The UCA is responsible for the display part. The control and model parts are usually implemented in the agent in form of the GUI Control and the Agent Code itself. For performance reasons parts of the GUI Control may be transferred to the applet in form of Java Beans. Our framework provides for the seamless communication between the parts hiding nearly all aspects of distribution.

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In effect the whole system resembles a little bit the X11-system [Scheifler et.al. 1992] with the agent being the X11-client and the UCA being the X11-server. In contrast to X11 our system is written entirely in Java, is completely object-oriented and uses advanced communication mechanisms like software buses and Remote-Method-Invocation (RMI). Another major difference is that we are able to transfer mobile code to the display applet which can be used for enhanced functionality of performance.

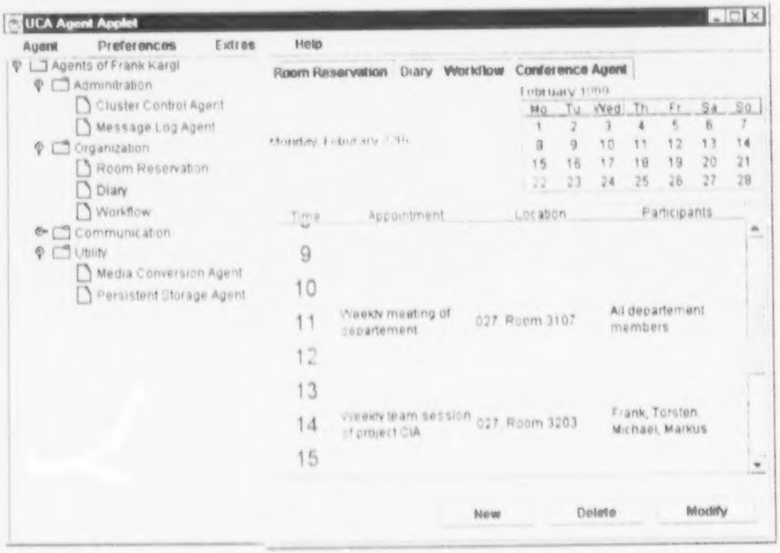
While designing the general layout of this model, we identified three major problems:

- The applet must be flexible enough to display any user interface imaginable for any number of agents in parallel.
- The agents need a way to describe the composition and structure of their user interface at run-time.
- User interaction generates events like button pushes etc. that must be delivered to the appropriate agent.

Our prototype implementation of the infrastructure is based on Java 2 so a Java 2 solution to these problems had to be found.

UCA Applet

[Figure 2] shows the applet with an active diary agent displaying its user interface. Each agent is assigned a separate tab where it can display its user interface. As this tab is a general container that makes no pre-assumptions, agents are completely free to build their user interface. They can even spawn new windows that are totally independent of the rest.


UCA Agent Applet
Agent
Preferences
Extras
Help
Agents of Frank Kargl
Adminitration
Cluster Control Agent
Message Log Agent
Organization
Room Reservation
Diary
Workflow
Communication
Utility
Media Conversion Agent
Persistent Storage Agent
Room Reservation
Diary
Workflow
Conference Agent
New
Delete
Modify

February 1999

Mo	Tu	Wed	Th	Fr	Sa	So
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Time	Appointment	Location	Participants
9			
10			
11	Weekly meeting of departement	027, Room 3107	All departement members
12			
13			
14	Weekly team session of project CIA	027, Room 3203	Frank, Torsten, Michael, Markus
15			

Figure 2: The UCA Applet

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UCA Server

The server part consists primarily of two proxies, the GUI and Event Proxy, that translate Agent Bus events to RMI calls and vice versa. When an agent wants to do any changes to its user interface, it generates specific Agent Bus events that are translated to RMI function calls in the GUI Proxy. In reverse direction events generated by the user interface are caught by RMI event-handlers and are then translated to Agent Bus events in the Event Proxy.

Dynamic Interface Construction and Manipulation

As explained above, each agent is assigned an empty container within a tabbed pane in the UCA applet where it can construct or manipulate its user interface. It does so by using our *Dynamic Interface Construction and Manipulation* mechanism (short DICM) which supplies the following possibilities:

- Creating new components using *create()*
- Manipulating existing components using *call()*
- Integrating existing Java Beans at runtime into the applet

All these mechanisms work locally as well as remote via the Agent Bus or RMI. For ease of use we have encapsulated DICM in a complete set of remote components, so a user just needs to build a local component hierarchy that is automatically mirrored and displayed in the UCA applet.

Creating new components using *create()*

Starting from the initial container, remote objects can create new components in the applet using the *create()* call. The call takes three arguments: a base container where the component is added to, the class of the component to create and a name that is assigned to the newly created component. As every AWT component has a name attribute and all components are arranged in a hierarchy, we can access every component starting from a single container. An example usage of *create()* may be:

```
guicont.create("startcontainer.firstpanel", "javax.swing.JButton", "okbutton");
```

This will create a new *JButton* component, name it "okbutton" and add it to the component named "firstpanel" contained in "startcontainer".

Modifying existing components using *call()*

If we want to modify existing components we can use the *call()* method. We need to supply three arguments: the name of the component to modify, the method to call within the component and an argument list to the method. Call invocation is done using the Java Reflection mechanism [Sun 1999]. The following code will set the text attribute in the button created above:

```
String[] args = { "new buttontext" };
Object result =
     guicont.call("startcontainer.firstpanel.okbutton", "setText", args);
```

Transferring existing Java Beans

Both *create()* and *call()* work well for small graphical interfaces or slight modifications to existing ones but it is quite cumbersome building large user interfaces this way. Consequently there is a third way for an agent to display and manage complex structures in the UCA: mobile code. A complete user interface or complex subparts of it can be developed as one or several Java Beans. An agent then transfers the complete bean into a Bean Repository located in the UCA applet and instantiates it as needed. Subsequent method calls to this bean are again done using the *call()* method described above. The transport of bean code to the applet is a quite complex process. In our current prototype the agent transmits the bean code (read in from the class file) to the GUI Proxy via the Agent Bus. The bean is then sent to the Beans Repository in the applet. There's a custom classloader for instantiating any of the beans in the repository.

In a future implementation we will use Java Spaces [Sun 1999] for the same purpose. Beans can then even be stored in a Persistent Object Space (POS) [see Kargl et.al. 1999] and can be retrieved as needed. Beans are instantiated in the applet using a custom class loader.

Remote Event Model

Now that we have constructed our remote interface we need a way to relay user generated events (like menu selections etc.) back to the agent. Starting with version 1.1 Java uses an event delegation model. Components (like buttons, menus etc.) generate events that are delivered to previously registered event handlers. We have extended this model so event handlers can not only be local (that is within the same virtual machine) but also remote event handlers can be used. This requires slight modifications of the standard API (making event handlers throw java.rmi.Remote exceptions) but works absolutely fine otherwise. The changed standard API is only used for the proxies and the applet. Agents are developed using the normal JDK. Now an agent simply registers its event handler routine with the respective component in order to get notification of all events generated by this component. There's a event proxy for translating the RMI calls to Agent Bus events, so the remote event mechanism is even independent of the underlying transport mechanism.

We have conducted various performance tests that show the effectiveness of our approach. [Table 1] shows the results measured in calls per second. The first test called *Local Event Handler* creates a component and fires action events to a local event handler routine. *RMI no argument* calls a method using RMI and passes no arguments. *RMI ActionEvent argument* does the same but passes an ActionEvent object to the method called. Finally *Remote Event Handler* does the same as *Local Event Handler* but calls a remote event handler routine. All tests were done using 200MHz Pentium Systems running Windows NT 4.0, JDK 1.2. The machines were connected to a local 10 Mbit Ethernet segment.

Calls/s	**Local Event Handler**	**RMI no argument**	**RMI ActionEvent argument**	**Remote Event Handler**
local	6405	839	372	386
remote	N/A	831	358	358

Table 1: Performance Tests

How can we interpret these results ? Remote event handlers have a potential throughput of about 350 events per second. As the *RMI ActionEvent argument* and *RMI no argument* tests indicate, this seems to be primarily due to the RMI call and marshaling/unmarshaling of the Action Event argument. Using such RMI calls for Event Handlers adds no additional overhead. Although 350 events per second are much less than the maximum of 6400 in a local scenario, it is enough given typical user interface scenarios. Normally events are generated by mouse-clicks and no user will produce more than one or two clicks a second. Even resize events that affect many components at once aren't critical given that there are seldom more than 50 components in one user interface. Our prototype confirms this as an ordinary user can't detect any significant difference between local and remote event handling. If any user interface would get into performance difficulties due to event handling, it can still be integrated into a bean which can be executed locally in the applet.

Conclusion and Outlook

Display systems like the one described in this paper may become necessary whenever you want to control or operate a distributed system of heterogeneous applications (not only restricted to software agents) from within one application or applet. Other agent systems like IBM Aglets / Tahiti [IBM 1999] often don't address this problem, as they only allow the display of user interfaces from agents residing on the local host.

As our work clearly indicates it is possible to realize ultra-thin clients with Java that have practically no application specific logic built-in. Instead they merely represent a highly-functional display server similar to the well established X11-servers. Due to the broad availability of Java enabled browsers our system can be used nearly everywhere. By using a set of remote components, applications can use this "display server" in a nearly transparent manner through an easy to use interface. When transferring complex components to the display application the communication overhead can be minimized.

When realizing the bean transfer and remote event model you often interfere with the security mechanisms in Java applets so policy files are necessary for granting certain rights to the applet. The efficient installation of these policies at the user is one of the unsolved problems yet.

Our next extension will be an even more generalized DICM mechanism so user interfaces described by agents will automatically adapt to a wide range of possible displays like PCs, PDAs or possibly even voice control.

References

Buschmann, F. et.al. (1996). *Pattern-Oriented Software Architecture.* New York: John Wiley & Sons, Ltd.

IBM (1999). http://www.trl.ibm.co.jp/aglets/tahiti1.1/index.html

Kargl, F. & Illmann, T. & Weber, M.(1999). CIA - a Collaboration and Coordination Infrastructure for Personal Agents. *Distributed Applications and Interoperable Systems II*, 1999, IFIP TC6 WG6.1. 213-218.

Scheifler, R.W. & Gettys,J.(1992).*X Window System.* Burlington, MA: Digital Press

Softwired Inc. (1999). http://www.softwired.ch/products/ibus/

Sun Microsystems Inc. (1999). *Reflection FAQ.*
http://java.sun.com/products/jdk/1.1/docs/guide/reflection/faq/faq.html

Sun Microsystems Inc. (1999). *Java Spaces Specification.*
http://java.sun.com/products/javaspaces/specs/index.html

Web-Based Training in Banking and Finance: Requirements and Strategies

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1 Introduction

Due to the high rate of innovations in products and procedures traditional means of education are not adequate for life-long learning of the banking staff. The short life time of modern financial products requires immediate marketing and therefore quick and complete education of the personnel involved in selling this product.

German banks are expanding beyond their traditional market place. Therefore, the marketplace for educational services in the financial sector will be European and global, with great increases in the quality of education available to the individual at lower real costs per capita than conventional education today. Today, in-depth banking knowledge is needed outside the core financial industry (the so-called near- and non-banks) as well. In order to implement complex financial transaction systems the programmers of financial software need to be trained in the subject matter.

1.1 New means of communication and training

We consider electronically mediated education as a major source for ongoing education in the international knowledge-based economy. Computer, television, satellite, fibre optics and other technologies combine to create a vast interactive communication and information network.

The banking sector is leading in the development and adoption of electronically supported workplace training and is now moving towards distance education and integrated multimedia learning environments to cope with the scale of vocational training and communication requirements. As of today, many distance learning projects are realized by means of conventional media, such as printed matter and telephone tutoring. We consider electronic performance support systems (in the form of on-line media and self-directed learning environments) to be the only effective solution in terms of cost, time and logistics.

From an economical point of view it seems clear that costs can be reduced drastically. Little is known, however, about the effects of tele-cooperation upon corporate identity, learning behaviour, and communication processes (Sproull & Kiesler, 1991). Several studies compared computer conferencing via e-mail, video conferencing, telephone conferences, and personal communication. They ascertained that video conferencing is much more like telephoning than like personal communication. But simple e-mail conferences can provide several advantages as Sproull and Kiesler (1991; Kiesler, 1992) discovered: Personal communication takes less time but electronic mailing leads to agreements more frequently. Additionally, conferencing by e-mail allows for a more symmetrical participation than personal discussions. Banks and their departments for human resources development aim to take advantage of these new technologies.

2 Requirements for Web-Based Training (WBT) in German Banks

Learning to learn and learning to select and process information effectively will be key skills in the information society. Major objectives for new learning environments are: supporting and understanding how to cope with a rapidly growing amount of information, helping to manage the learning processes, supporting active, self-paced learning, and finding effective models for assessment and evaluation of the learning and teaching processes. The research on constructivism and situated cognition supports the idea of a new role for teachers and interactive learning systems. The main idea of constructivism and situated learning is learning as an active construction of knowledge instead of passive absorption of knowledge. Additionally, physical and social aspects of the learning situation have to be considered (an overview is provided in Duffy & Jonassen, 1992).

All media provided in the learning process should be linked to well defined learning goals, pre-knowledge of the students, and appropriate amounts of information. Positive pedagogical effects can only be elicited by the careful use of multimedia: New technologies solve technological problems, but they do not solve pedagogical problems. We can take advantage of new technologies by transforming the traditional classroom setting and initiating a smooth transition from classroom settings to fully interactive electronic learning environments using digital TV, World Wide Web, and electronic feedback devices as a technological basis. The benefits of this approach are:

1. By eliminating travel and lost production costs, we can reduce overall training costs.
2. By creating virtual classrooms, we extend single learning facilities to an integrated international learning environment.
3. We foster on-the-job training to reduce the amount of time spent away from the job and thus help to improve worker productivity.
4. By making training more timely and accessible, we increase skill transfer and improve effectiveness.
5. By providing managerial expertise, we can track and store training information and multimedia material for the corporations.

This new approach to learning needs to be reflected in the infrastructure used for education. Traditional Computer Based Training (CBTs) provide self-contained learning environments and often strong guidance for the user (e. g. by providing learning paths based on tests). In the open world of the Internet and corporate Intranets this strategy is no longer enforceable. Furthermore, external resources, such as real-time data and corporate manuals can be integrated into the learning process. But even more interesting is the integration of learning into every-day work: Education is available on the spot and will be integrated into other information resources.

Communication is an integral part of learning. This was widely neglected by many CBTs (where the learner could only "talk" to the program). Since the learning system is part of the Intranet infrastructure it can easily interface with communication systems such as electronic mail and discussion boards. As part of the Intranet the system has to integrate into the design style guides. It is desired (and often strictly enforced) that most of the applications found in the Intranet provide the same basic structure and design (e. g. style guide and corporate design).

Most of the bigger German banks have been working to establish corporate Intranets for quite some time. These networks are slowly evolving from a domain of the IT departments to a widely available resource with a unified user interface and structure, and central organization. They are slowly getting accessible to people outside the corporate headquarters, although bandwidth outside the headquarters is still a major issue.

It is still undecided where the employees are supposed to learn. One of the main advantages of WBT often cited is its ubiquitous availability allowing employees to learn during their breaks or in off-peak time at their workplaces. We question that those short intervals will be appropriate for effective learning. Rather, we suggest allocating longer and uninterrupted periods of time for first time learning. Some banks have installed learning computers in their major branches where the employees can retreat for learning a subject the first time. The refreshing of knowledge, however, can ideally be done directly at the workplace.

3 First Systems and Results

Bankakademie is a non-profit organization with a membership of about 3.500 German banks and key player in the educational market for the German banking industry. We were asked by a major German commercial bank to study the requirements and effects of Intranet Based Training. It included a study of the previous situation, a prototypical implementation of a course on currency management and the evaluation of a first group of 80 learners. The system was based on an early beta version of the Hyperwave Training Space (formerly known as GENTLE, Dietinger, 1998), an application that runs on top of the Hyperwave Information Server (Maurer, 1998).

Content and Design. The general layout and design of the system had to be adapted to the corporate Intranet. It turned out that the existing Intranet style guide was not fully applicable to the new learning system, since it was targeted on systems for information consumption rather than learning and communication. Therefore, a modified style guide for WBT was developed and approved. The system is fully integrated into the Intranet: It features as part of the bank's "Virtual Learning Centre" and can be accessed from any computer within the bank.

The content was developed by a CBT author in cooperation with the subject expert group. The pages were the programmed as normal HTML pages containing Java and JavaScript interactions. On request of the bank, the content is quite "CBT-style": There are questions and interactive images on about every second page. Due to the anticipated bandwidth problems we refrained from integrating video. Audio was only used in communication exercises.

Online Evaluation and Testing. Every module came with a test. Taken as a pre-test, it allowed the students to assess which modules they needed to see. Taken as a post-test, it showed the students whether they had understood the content of this module. No automatic actions such as prescribing a certain learning path were undertaken, for privacy reasons the test results were not stored. A short evaluation questionnaire was offered on-line after each module. The students were asked whether they regarded the module as appropriate and how they rated the quality of the material. The summative rating of all fellow students was displayed with the questionnaire.

Notes and Forum. As mentioned above, the integration of communication facilities is one of the main advantages of WBT over classical CBT. Communication was realized by notes and forums. The student could add a note to any point of the text (Figure 1). Every note could be labelled *private*, to be seen by the student only, *learning group*, to be seen by the student and his virtual learning group or *public*, to be seen by all identified users. It is one of the main features and advantages of Hyperwave that all pages are personalized on the fly: Every student is presented with the notes he is supposed to see, at their defined positions. Every note is typed. For the prototype we defined *remark, question, answer, agreement* and *disagreement*. All notes marked as *question* are automatically forwarded by email to the tutors in charge of this module. The tutor can then jump directly to the page in question and enter the answer directly into the system. In a future system the students will be informed by email on every response to their note. During the prototype test this was not possible due to privacy requirements of the contestants.

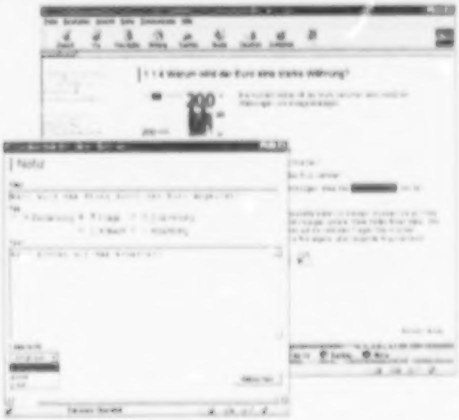

Figure 1: Note taking on-line: The note is connected to the highlighted text area.

All notes tagged as *learning group* or *public* are automatically integrated into the forum of this course. This allows for an overview of the activity within the course and shows which answers have already been answered. It turned out that the notes are a very valuable tool for the long-term maintenance of the material, since the notes are directly connected to the passage that was wrong or mis-understood.

Search and Background Library. The entire system can be searched. All HTML pages are indexed in Hyperwave's built-in fulltext server. Only the text that appears in animations (i. e. presented by Java applets) cannot be searched. Since notes are documents stored within Hyperwave, they can be searched as well. Students can either search the current lesson or the entire CBT. Each lesson can be complemented by a background library that contains additional material, such as the text of the relevant laws, corporate handbooks, etc. Section 5 illustrates this in detail.

3.1 Results

Different groups of altogether 80 users, each working with different versions of the bank training system, participated in the study. Two traditional two-day seminars were surveyed to compare traditional and Intranet learning.

The evaluation indicates that Intranet-based training equals or is slightly superior to classroom teaching tak-

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ing only 50% of the study time of classroom learning. The learning results did not differ substantially for the different settings tested. Additionally, we examined the following factors:

- Self tests and surveys were presented with and without direct feedback. Providing direct system feedback for inputs into surveys clearly supports the acceptance of the respective facility.
- The learners were either asked to read all pages in sequential order (sequential learning) or to decide if and what to read after studying a summary and doing a self test (selective learning). Furthermore, the learners were asked to work on their own or to collaborate in a five-person learning group. The learners preferred a traditional learning style, that is sequential and individual learning.
- Half of the students were presented graphs and animations with additional explanations, which are provided as additional texts or audio files. Using sound and animation marginally enhanced acceptance ratings and test scores.

The analysis of the users' notes and the module surveys revealed that the content was too specialized for some and too general for others. The course will be re-structured to cater for the different learning needs and was rolled out for a larger trial with a target audience of 1.500 employees in July 1999.

4 From CBT to WBT and KM

CBT has been around for quite some time and is widely employed. However, there is a need to integrate CBT into a larger management framework in order to distribute and use it over networks.

First standards for interfacing traditional CBT are emerging: The *Aviation Industry CBT Committee*[1] defined standards for interfacing CBT modules to a management system and to each other. The IEEE and the European Union are jointly developing standards for meta information for computer mediated instruction[2]. This shows a trend towards integration of small CBT units into a greater framework. However, these structures can only handle on a very coarse level of granularity. But this is exactly one of the strengths of the World Wide Web: different documents can relate to any other document within the Intranet or the world-wide Internet. WBT allows for better adaptability: Different target groups may use different parts of the same training material. Easy and unified access mechanisms (e. g. by search engines and directories) allow for immediate access to the entire corporate learning resources.

Systems are under development that aim at integrating and controlling the entire corporate learning process, from training needs analysis to production and deployment on a general level as well as registration, budgeting, and the training itself on the personal level. The system Columbus by Deutsche Bank is a first system of this kind and will be deployed soon. The investment in traditional CBT will need to be preserved by integrating them into the new learning architecture. But on the long run we expect this technology to be replaced by true web applications (see section 4.1). The other trend is the integration of many resources into corporate Intranets and the unified administration and access mechanisms as part of the Knowledge Management (KM) cycle. As will be demonstrated in section 5 below, training resources will be an integral part of these networks. Therefore, we have to make sure today that the interfaces of our systems are open to be integrated into these frameworks.

4.1 Migration of Content and Infrastructure

Most of the traditional CBTs have been developed by multimedia authoring systems. A large number of developers have been trained in using these systems and large libraries of components have been developed. The supporters of these systems propose integrating the CBTs as downloadable modules into the Intranet. For example, Shockwave is a file format that can be generated by the authoring system Macromedia Director. These files can then be loaded from an Intranet server as any other document and displayed by special add-on programs (plug-ins) to the users' Web browser. This preserves the investments into the CBT, it can be fully re-used in the Intranet. Specialized servers, such as Asymmetrix Librarian provide a framework for the delivery of these modules. However, there are a couple of disadvantages connected to this approach:

- There is not one single standard for CBT delivery. Different authoring systems produce different file formats and require different plug-ins.
- Plug-ins are generally not favoured by the corporate IT departments, because they are seen as additional cost

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[1] http://www.aicc.org/

[2] IEEE P1484.12 Learning Objects Metadata Working Group (http://ltsc.ieee.org/wg12/index.html)

for system maintenance.

- These modules are usually quite large. They have to be loaded entirely before they can be displayed.
- The content of these modules generally cannot be indexed by search systems and therefore does not integrate into the overall infrastructure. If the modules are indexable then the single units of information (screen page) are not directly accessible to the interested user (imagine pressing "page forward" 100 times before you reach the needed page).

In a project for GMAC European Operations,[1] Bankakademie and Raytheon chose a different way. The CBT content is produced as HTML pages (including JavaScript and Java animations and interactions) and then installed into the Hyperwave Training Space. In the near future, the training modules will be available in 5 languages and centrally administrated and maintained within the server. The pages are then extracted by a special tool from the Hyperwave Training Space (taking advantage of the personalization features of Hyperwave). Some special features, such as bookmarks and a search engine have been implemented using Java and JavaScript. This conglomerate is then transferred onto CD-ROM. The end-user can access the CBT by a standard Netscape browser.

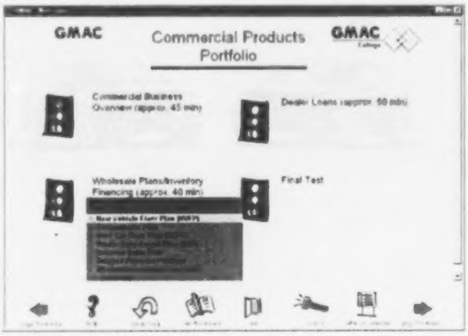
GMAC
Commercial Products Portfolio
GMAC College
Commercial Business Overview (approx. 45 min)
Dealer Loans (approx. 90 min)
Wholesale Plans/Inventory Financing (approx. 40 min)
Final Test

Figure 2: Table of Contents for GMAC CBTs. The traffic lights indicate the learning progress.

As soon as the corporate Intranet will be ready, the learning system can go on-line right away. Communication features as described earlier can be added at this point. There is no need for changing the content pages. All necessary changes will be done within the Hyperwave framework.

5 Integration into Knowledge Management

The integration of Intranet resources into education is not a one-way process. There is not a separate educational framework available in future Intranet designs, but the education modules are integrated into the information interface. Learning is tightly integrated into the personal working environment.

Bankakademie is pursuing this idea by integrating its educational resources with other available material into one unified system of delivery. Bankademie's printed base material is a 4.500 page loose-leaf body of material called "Studienwerk". This work has been converted to SGML and is now available for Intranet use. Based on the consolidated index of Studienwerk, we are developing a hierarchical thesaurus of banking knowledge. Into this thesaurus other materials of Bankakademie will be integrated as soon as they are available. However, this structure is open for other materials such as bank-internal manuals and handbooks. Additionally, a full-text search will be available for all materials. The users can personalize the material by adding notes and bookmarks.

As stated above, this architecture has to be open for the integration of resources of divergent origins. Formats based on open standards such as SGML and systems that preserve content structure and meta information (such as Hyperwave) guarantee that the content developed today can be re-used in future systems.

Examinations and self tests are another area of our activities. In the process of dealing with over 12.500 students a year, huge amounts of exams and other testing material is produced and distributed. We developed the

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[1] General Motors' financing subsidiary for Europe, e. g. Opel-Bank in Germany, Vauxhall Finance in Britain

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question and test database CertiFire® to streamline this process. CertiFire comprises three modules: authoring, administration and testing. Most of the questions can be evaluated automatically, but we also provide essay-type questions that have to evaluated by the students themselves or a tutor. Every question can be assigned to multiple contexts, described by mode, target group and subject area, but it only has to be maintained once. Based on these contexts exams or self-test modules can be generated. These tests can be delivered in four different ways:

- by our electronic testing environment on a (stand-alone) Windows PC, all results can be fed back into the administrative database;
- via a CGI program through any browser, the results are fed back into the database;
- by a Java applet that retrieves exam files from a Web server;
- on paper (still requested by many of our customers).

Therefore, tests generated by CertiFire can be integrated directly into the learning environments described above, without creating additional administrative costs. An evaluation study conducted in 1998 examined the impact of Intranet-based testing and simulation tools within a bank training framework. The results of the study confirm that using testing and simulation tools does not affect the actual test results in comparison to paper-and-pencil work. The use of multimedia tools, however, was able to enhance acceptance judgements and self confidence of the users.

6 Future Work

Future research has to focus on the interaction of key aspects of learning. This implies that simple experimental settings, which aim to study main effects, such as comparing two types of media, are not too promising. Relevant advances in networked multimedia computer environments will emerge, if recent results of basic research are applied explicitly and the evaluation criteria meet the demands of the practical use of computer environments. Furthermore, the necessary network infrastructure is not in place yet. If existent, it is often inappropriate for "full multimedia", including audio and video. But nevertheless, it is possible to develop and deploy the module of the new architecture already today. Systems and standards have to be open for the likely case that our ambitions will outgrow the systems that we are developing today. For the future we do not expect to see CBT in a new networked gown, but as an open, adaptable and extensible platform, that allows for integrated learning, information, and communication services.

7 References

Boettcher, J. (Ed.) (1993). 101 success stories of information technology in higher education: The Joe Wyatt challenge. New York: McGraw-Hill.

Dietinger, T. (1998). GENTLE - (General Networked Training and Learning Environment) EdMedia 1998, 10th World Conference on Educational Multimedia and Hypermedia, AACE.

Duffy, T.M., & Jonassen, D.H. (1992). Constructivism and the technology of instruction: A conversation. Hillsdale, NJ: Lawrence Erlbaum.

Hasebrook, J. (1995). Multimedia Psychologie. Eine neue Perspektive menschlicher Kommunikation (The Psychology of Multimedia, in German). Heidelberg: Spektrum Akademischer Verlag.

Kiesler, S. (1992). Talking, teaching, and learning in network groups: Lessons from research. In A.R. Kaye (Ed.), Collaborative learning through computer conferencing (pp. 145-165). Heidelberg: Springer.

Maurer, H. (1998). Using the WWW System Hyperwave as the Basis of a General Networked Teaching and Learning Environment, CIT, 6(1).

Sproull, L. & Kiesler, S. (1991). Connections: New ways of working in the networked organization. Cambridge, MA: MIT Press.

jCentral: Search the Web for Java

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Abstract: jCentral (http://www.ibm.com/developer/java) is the largest repository of Java resources on the Internet. It provides advanced, Java-specific search, orientation, and notification services for application developers to locate and subsequently use Java resources such as applets, beans, source code files, newsgroup discussion articles, FAQ's, and other related documents. We present the design and implementation of jCentral, and offer insights and highlights from the experience we have gained so far.

1 Introduction

Java has become the language of choice for application development. It has also emerged as a possible open environment for component-based network computing due to its platform independent bytecode standard and built-in support for programming applets (small applications that can dynamically migrate over the network and execute on the fly on the user's client machines). Java has also benefited tremendously from the explosive growth of the Internet: unlike any other programming language, information and artifacts about Java such as manuals, FAQ's, source code files, are widely available on the World Wide Web in large amounts.

Furthermore, the combination of the world wide accessibility of the Internet and the abundance of Java artifacts on the Web has given rise a historic opportunity to address the challenge that has faced the software engineering community for decades: how do we effectively locate, trade, and reuse existing software artifacts to significantly improve the productivity of software development? A number of online Java resources web sites, such as Gamelan, Java boutique, and others, have been developed. However, these sites rely on users' submissions as the basic means of obtaining their Java resource repository, and are thus unable to include the vast amounts of useful Java resources that are out there on the net. In addition, they typically provide only textual search and retrieval facilities that are insufficient for Java developers to accurately find the classes/applets they can use, or the source code they can look at as examples. For example, a programmer looking for a radio button applet or a sort method with a certain parameter-result signature, would like to express his or her query in such a way that resources that are directly related to these concepts will be matched by the search engine based on their content and usage context, not just the appearance of certain strings in their descriptions.

jCentral addresses these challenges by providing the Java developers community with a comprehensive online Java resource center targeted to the specific attributes of this domain. Currently, jCentral is the largest Java resource center containing almost every Web accessible Java applet, Java source code file, Java bean, Java newsgroup article, and any other Java related document, such as FAQ's and product news, that are available on the Internet. It is designed to find and store information about an unlimited amount of Java resources, to offer an effective, extendible, and Java specific search engine, and to help the user evaluate some important attributes of the resources it finds. It knows how to find Java related resources by means of content directed crawling, it provides a mechanism for contributors to submit their own resources in addition to what is available through regular crawling, it features an innovative user interface to describe Java resources in a domain specific fashion, and it offers ways to view the resource it find in context so to enable their effective usage in the user's application.

The jCentral project started in the summer of 1997 and our site was officially launched at the JavaOne conference in March 1998. Since then, we have received an overwhelmingly positive response from the Java developer community. This paper is a first-hand report about both the technologies behind the jCentral site as well as insights and experiences gained on how jCentral is able to help Java developers to find the Java resources they need and enhance their productivity.

2 System Architecture

The jCentral system consists of three main components, the Java resource gathering facility, the Java resource repository, and the search/notification/navigation frontend. This section will describe the overall functionality and structure for each of the components; and highlight the technical challenges in the development of those components. Specific technical details will be provided by subsequent sections.

jCentral's Java resource gathering facility is built upon the IBM Grand Central Station (GCS) System. GCS inherits the distributed Gatherer/Collector architecture pioneered by Harvest. Each Gatherer functions as a much extended crawler that gather and summarize resource from a variety of data sources, such as Web server and database servers, in a variety formats such as HTML and relational database tables. jCentral extends the GCS Gatherer with mechanisms that are specific to the needs of gathering Java resources over the Internet. Among the many technical hurdles we have to overcome, the following two challenges stand out. The first is how to efficiently gather Java resources from the Internet where there are more than three hundred millions of Web pages. Second, Java resources such as Applet and Beans are linked to the Internet in special structures much more complicated than normal HTML pages. We must develop new techniques that can systematically discover and collect all publicly accessible Java resources on the Internet. Detailed discussions on these issues are in section 3.
Large-scale resource gathering is only the means of building up the jCentral Java resource repository. Note that the jCentral repository does not directly store the original content of the gathered resources. Instead, for each Java resource, whether it's an applet, a bean, a source code file, or a newsgroup article, we create a meta-data stored in the XML format that contains salient features useful for searching Java resources. The technical challenge here is developing analysis mechanisms that can understand not only the data format of the each of the Java resources but also the semantic relationship among different resources so that meaningful and descriptive features can be automatically extracted and stored in the repository. Section 3 will discuss the specific details.

Even with a large collection of Java resources, how to enable users to conveniently and effectively search and locate the Java resources of their interests or needs still presents plenty of challenges. First, Java resources such as applets and beans are very complex objects, where simple text search will not be sufficient in finding accurate Java resources. jCentral designed new advanced and search facilities that allow Java developers to query resources with Java specific feature constraints. Second, multiple Java resources, although may physically be located on separate servers or container files, can be semantically related to one another. For example, the class and sources files of a popular applet (e.g. the lake applet) can appear on thousands of Web pages. When the user finds one of them, it is highly desirable that there are mechanisms to help guide the users to locate other resources that are related in some ways. Finally, the Internet and online Java community evolves at a rapid pace. Even if the Java resource sought by a Java developer in jCentral does not exist in resource repository, it may show up the next day as jCentral crawls the Internet continuously. Therefore, jCentral offers a notification service so that the Java users can simply tell what resources they are interested in and jCentral will automatically notify them via email as soon as one matching their needs is found. The technical details of the jCentral searching, navigating, and notification mechanisms are presented in sections 3, 4 and 5.

3 Java Resource Gathering

Efficient large-scale Java resource gathering faces the following two main technical challenges. First, we need to be able to control a collection of distributed gatherers and direct them to destinations that tend to lead to Java resources. We address this problem with a scalable distributed team crawling scheme [3] that prioritizes the discovered links to quickly get to sites that contains Java resources. Given the relatively low percentage of Java relevant sites, our gatherer dramatically increases crawling efficiency by prioritizing the URLs before actually accessing the web pages.

Second, the gatherer must be able to follow the Java-specific links such as applet class references to chase and gather relevant resources. This problem is solved by integrating a specialized Java resource analyzer into the gatherer. This analyzer understands the structure of each kind of Java resources, applet, bean, source code file, or a Java newsgroup article.

3.1 Java Resource Analysis

For each gathered Java resource, jCentral runs through an analysis phase to extract all the key features and store it an XML meta data file in its repository. jCentral includes four main analyzers for the following types of resources: Applet, Bean, Source and News.

3.2 Search Interfaces

The jCentral resource repository consists of a variety of contents from simple text documents in Java newsgroup articles to complex objects such as a Java bean. Therefore, the traditional textual keywords-based query interface is not sufficient for the users to quickly and accurately find the Java resources they want. jCentral's approach is to provide a suite of search facilities that can address different aspects of the users search needs.
The jCentral user enters a query from its Web Browser in a HTML form. There are currently three types of HTML based forms available:

1. Basic Search (http://www.ibm.com/developer/java)
2. Power Search (http://jcentral.alphaworks.ibm.com/power.htm)
3. Advanced Power Search (http://jcentral.alphaworks.ibm.com/powersearch.htm)

Basic Search

The Basic Search provides only one line for text input and looks similar like other search engine's user interface. Boolean operators and other common search primitives are supported (wildcard search, stemming, etc.) [8].

Power Search

The Power Search allows the user to search using Java specific search attributes. The form is divided into five categories where the user can search in (Applets, Beans, Source Code, related newsgroup articles and other Java resources).

4 Notification Service

The notification service allows registered jCentral members to submit a persistent query and monitor the Internet for new Java resources. Each resource type belongs to one of the five channels Applets, Beans, News, Java Source and Other Resources and enables users to set up a fine-grained interest profiles. The following user profile gives an example of a typical subscription profile.

Applets: Network or 3D or VRML or proxy
Beans: Enterprise or database
News: e-commerce
Java Source: Jdbc or class loader
Other Resources: Servlet Express

When a sufficient amount of new resource items has been collected, the system sends out e-mail summaries showing any matches for the interest profile.
The foundation for our information dissemination technology is a scalable webcasting system [4], [5], which is able to efficiently match diverse data against a large set of user profiles. The heart of the webcasting system is the profile engine, which maintains a large profile database and matches any incoming data item against all user profiles. Data satisfying certain profiles is temporarily stored on disk until a notification message has been mailed to the user. The key concepts of the profile engine are the compact representation of the user profiles and the efficient evaluation algorithms. Internally, the profile engine represents each user profile as a graph where the Boolean operators of the profile language are mapped to inner nodes and the text predicates are mapped to leaf nodes of the graph. The graph structure parallels the logical structure of the Boolean profiles. The profile engine absorbs new subscribers without severely degrading performance because text predicates and common sub-expressions are shared among all subscribers. The user profiles from our current deployment shows that users have shared interests. After reaching a certain scale, most common interests are represented in the system. As a result, the performance degradation incurred by admitting new users will be limited.
The matching algorithms dynamically monitor the evaluation process and adjust to evolution in the digital content. This allows the system to sustain high performance over time. To be able to process all collected data items in a timely manner the profile database can be partitioned and distributed across multiple machines.

5 jCentral Class Navigator

The Class Navigator is a tool for visualization of the search results. This tools, implemented as an Applet, visualizes many additional relationships of the selected result compared to regular search engines. Among these is are the class hierarchy, reference relationships, and various OO class characteristics. All this information is presented to the user in a compact way, creating a comprehensive understanding of the results.

5.1 Motivation

There following reasons have lead us to integrate the Class Navigator as an additional means for visualizaing search results. First it provides the user with all the information required, in order to allow him to reach a Go/No

Go decision as fast as possible. The second advantage of this tool is the ability to navigate the very large repository of classes available in jCentral. Third, the Class Navigator is capable to present the inter-results relationships to the user.

6 Experience

Over the last 6 months the jCentral repository has been continuously grown in terms of content. From an initial size of 100,000 Java resources it went up to over 350,000 Java resources (Java Applets, Java Beans, Java Source Code, Java related Newsgroup articles, and other Java related resources) by the beginning of October. For this reason we were able to gather a lot of feedback, experience and data of the queries the user issued as well as interesting facts about the Java resources currently out on the web.

Typically all traffic on a web site is logged into some log files of the web server. We developed some tools to extract this information out of these log files and transform the user queries into a computer interpretable format (based on XML) and store these in a database so that we can use to create interesting statistics about the user behavior. This

section presents statistical material about the current jCentral repository and also about the user queries we experienced during the last six months.

6.1 Repository statistics

In this part of the chapter we will present information and interesting facts about the current jCentral repository as of beginning of October 1998.

Distribution of categories in repository

The repository consists currently of 358,120 Java resources. These resources are distributed in the following categories:

Category	Number of resources
Java Applets	35,198
Java Beans	209
Java source code	86,298
Java related newsgroup articles	235,415
Other Java resources (white papers, tutorials, etc.)	767
Submitted Java resources	364

An interesting fact is that the Java source code is dominating. We didn't expect that there's so many source code available on the web in relation to Java applets.

Size of Bytecode (Applets)

After compiling Java source code the result is called bytecode, which is an intermediate format used for the interpretation of the Java virtual machine. Typically applets tend to be very small in size. These statistics presents the minimum, average and maximize size of the bytecode (measured in bytes) which is currently in our repository.

Minimum size of bytecode	343 bytes (0.3 Kbytes)
Average size of bytecode	4,519 bytes (4.4 Kbytes)
Maximum size of bytecode	142,668 bytes (139.3 Kbytes)

Classes used per Applet (associated classes)

A Java applet is a class file, which will be downloaded into the users web browser and there executed within the browser's environment. An applet however need not necessarily exist of only one class file. There can be many class files involved, which build together the applet. Class files can be bundled and distributed using a JAR archive file format (similar to the UNIX tar utility). The browser will download this archive and execute the main class and the associated classes.

Average number of class files per applet:	2
Maximum number of class files per applet:	29

Copyright protection

Some of the people who put their applets, beans or source code on the web want to have their copyright rights protected. Whereas there are other developers who are not concerned about legal issues. We were interested about the more general trend whether developers care much about copyrights when they make their intellectual property available public on the web. Note that jCentral in the case there's a copyright notice only exhibits general properties of this resource (title, description, etc.). However, for non-copyright protected resources it will present the full information, which is available from the bytecode or source code. An Interesting result is that less then 10% of Java developers are concerned about copyright issues. The percentage of Java applets found with copyright protection is 7.8 %.

Distribution of network domains

Another interesting aspect is the distribution of the Java resources (Java Source Code, Java Applets and Java Beans) within the top level Internet network domains (.com, .edu, .gov, etc.). It turned out that most the Java resources are hosted on academic and educational organization's servers (almost 40 %). Commercial sites do only host around 12.5 % of all Java resources of the jCentral repository. The rest is distributed almost equally (around 0.5 to 2.0 %) to the country domains. To mention here is that Japan, Germany, Austria, UK and Canada have a higher percentage that other countries. Note that these numbers only represent the distribution of the jCentral repository.

Category	%
.EDU	38.9
.COM	12.5
.JP (Japan)	7.2
.DE (Germany)	6.1
.AU (Australia)	4.4
.UK	4.3
.CA (Canada)	3.6
.GOV	2.6
.NET	2.3
Miscellaneous	18.1

1.1 Top 20 frequently used keywords in search

An interesting aspect is analyze what kind of keywords the users are looking for. Surprisingly the most used keyword in all searches was Java, since this is a Java only repository. The following keywords have ranked in the top 20 places : java, jdbc, servlet, applet, swing, rmi, for, html, visual, file, server, image, database, sun, visualage, notes, text, beans, francisco, search.

2 Future Directions

jCentral, as described in this paper, has already changed the way many Java application developers work. Rather than hunting for resources in a manual and unfocused manner, using inappropriate search engines and inadequate result viewing mechanisms, they can now direct their attention to the subject at hand and use the resources they find in an effective manner. Both our scaleable design and effective interfaces position jCentral as a robust framework that will serve the Java community well for quite some time.

There are several directions we are pursuing as a continuation of this effort. In many ways, jCentral is the first step towards an integrated web based application development and resource management environment for Java. Once found, resources can be filtered (according to a variety if criteria) and integrated into the user's applications. Tracking of enhancements, bug fixes, and other changes can also be made part of such an environment.

In addition, several other aspects of the repository can be enhanced to provide services found in search engines and sites that cater to other domains. First, a classification of resources according to evolving taxonomies is desirable; this will have to be done in an automatic fashion, given the shear size of the domain, and requires some further research. Other services include facilities for trading components and establishing ways to e.g. charge for royalties of licensed resources. Finally, similar systems directed towards other domains can be constructed using the concepts and techniques from our design.

3 References

[1] Information on the Fast Track, IBM Research Magazine, Vol. 35, No. 3, pp 18-21, 1997

[2] C. M. Bowman, P. B. Danzig, D. R. Hardy, U. Manber, M. F. Schwartz, The Harvest Information Discovery and Access System, Computer Networks and ISDN Systems 28, pp 119-125, 1995

[3] S. Teng, Qi. Lu, M. Eichstaedt, D. Ford, T. Lehman, Collaborative Web Crawling: Information Gathering/Processing over Internet, Hawaii International Conference on System Sciences, January 1999

[4] Qi. Lu, M. Eichstaedt, D. Ford, Efficient Profile Matching for Large Scale Webcasting, Computer Networks and ISDN Systems 30 (1998), pp 443-455, 1998

[5] M. Eichstaedt, Q. Lu, S. Teng, Parallel Profile Matching for Large Scale Webcasting, Lecture Notes in Computer Science, Springer-Verlag, pp 17-28, 1998

[6] Reiner Kraft, Qi Lu, Ron Pinter: System for Directly Accessing Fields on Electronic Forms, 1997, US-Patent pending, http://jcentral.alphaworks.ibm.com/powersearch-help.htm

[7] Reiner Kraft, Qi Lu, Ron Pinter: System for Creating Structured Fields on Electronic Forms, 1997, US-Patent pending

[8] JCentral online help pages Basic Search http://jcentral.alphaworks.ibm.com/basic-help.htm

[9] JCentral online help pages Power Search http://jcentral.alphaworks.ibm.com/powersearch-help.htm

[10] JCentral online help pages Advanced Power Search ://jcentral.alphaworks.ibm.com/adv-powersearch-help.html

[11] jCentral on-line help pages "jCentral - Class Navigator Help" http://jcentral.alphaworks.ibm.com/applets/classvis/help/help.html

[12] Yael Gafni and Eyal Fink technical report, Haifa Research Lab, in preparation 1997

[13] W. B. Frakes, personal communication, August 97

[14] W. B. Frakes and B. A. Nejmeh. "Software reuse through information retrieval". In the Proceedings of the 20th Annual HICSS, pages 530-535, Kona, HI, January 1987

[15] Richard Helm and Yoelle S. Maarek. "Integrating Information Retrieval and Domain Specific Approaches for Browsing and Retrieval in Object-Oriented Class Libraries". In the Proceedings of OOPSLA'91, Las Vegas, 1991

[16] Internet search service. http://www.hotbot.com

[17] Y.S. Maarek, D.M. Berry and G.E. Kaiser, "An Information Retrieval Approach for Automatically Constructing Software Libraries", in Transactions on Software Engineering, 17:8, August 1991

[18] "WebCutter: A System for Dynamic and Tailorable Site Mapping", Yoelle S. Maarek , Michal Jacovi, Menachem Shtalhaim , Sigalit Ur, Dror Zernik and Israel Z. Ben Shaul , Computer Networks and ISDN Systems, Elsevier Science, to appear. Also In the proceedings of the 6th WWW Conference, Santa-Clara, CA, April 1997.

[19] Pnina Vortman and Gabi Zodik. A Visual SOM Development Environment. IBM Object Technology 96

[20] Dror Zernik and Gabi Zodik. A graph management framework for 3D visualization. IBM Object Technology 97

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The Internet's Impact On Geography

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Abstract: This paper focuses on the impact of the Internet in relation to our understanding of geography. The growing reach of the Internet will soon see total global coverage. This relegates geographical barriers to secondary concerns when establishing sociopolitical and economic linkages. However, the question of whether geography will cease to matter is still unresolved. To answer this, the rise of the Internet is discussed from a geographical perspective. The paper then considers the Internet's impact on the way we conduct business, form communities, and establish new political identities. The discussion concludes with a call for greater geographical analyses of the present and future impacts of the Internet.

1. Introduction

> *"Soon geography will be irrelevant. Our ability to manipulate technology will play a larger and larger role in determining where and how we live."* (Ogden, 1995, pp. 25)

The veracity of Ogden's prediction is a matter of debate, but it is a fact that the Internet questions our traditional notions of geography. Indeed, as reported by **ABCNEWS.com** on October 13 1998, Tristan da Cunha, the remotest inhabited island on Earth has an Internet connection (ABCNEWS, 1998). No other communicative medium has as great an impact in as broad a scope, in the way we conduct our lives, as the Internet. It changes the way we interact with other people, establish relationships, conduct business, educate our young, form communities with common interests, and even travel the world. In each of these aspects, traditional concepts of geography are being complemented, and at times replaced, by a newer notion of the connected world. At one extreme, the Internet is seen as the ultimate form of democracy, bringing individuals from different backgrounds into the leveling field of electronic communication and network. Yet, nay sayers caution of the social ills of retreating into electronic cocoons, claiming physical interaction and socialization are necessary elements of community survival. Underlying these opposing views is the changing dynamics of our understanding of place, space and geography.

The task of understanding the impact of the Internet on geography is an onerous one. Unlike the influence of other technologies, the Internet is a rapidly evolving medium. Though it boasts a history of several decades, its direct impact on humanity spans less than five years. Hence, studying its impact requires a flexible approach, where conclusions of today become historical artifacts of tomorrow. But, some form of preliminary analysis is necessary lest the rapidity of change and the growing ubiquity of the Internet leaves us in its wake. Mapping its history, growth and influence in several key aspects in the way we conduct our lives will indicate how the Internet is affecting and shaping our notions of geography.

2. The Internet

Vinton Cerf, in the foreword to Gilster's (1993) book defines the Internet as

> "*a virtual space of software, networking, and computers, the Internet is infinitely renewable and infinitely adaptable, and it grows and changes every day.*" (Cerf in Gilster, 1993, pp. xix)

This definition encapsulates both what the Internet is and what it can become. Underlying the concept of the Internet, though, is its interplay with geography. The Internet can be seen as redefining our traditional notions of space. It creates a more dynamic form of connectivity, where proximity is a function of electronic linkages rather than physical distances. To understand how this fluid concept of space affects us now and in the future requires looking briefly at the rise of the Internet.

The history of the Internet began well before the notion of an interconnected global network of computers. In one sense, it is the culmination of developments beginning with the discovery of mathematics. In another, it is a way station in the progress of computing, before a new and fundamental change in telecommunication occurs. This can be seen from the different versions of the Internet's history found in cyberspace.

However, for the purpose of this discourse, the Internet's history can be traced to the development of the ARPANET in 1966 (http://www.darpa.mil). Devised as a command and control network that can survive the possibility of a nuclear strike, it used geography as the key to its functionality and feasibility. Hence, from the very beginning, geography played a critical role in the development of the Internet. The early concerns were issues of overcoming distances via computer networking to enable time and resources sharing among scattered mainframes. The main aim was to ensure effective communication even in the instance when one or more of the nodes in the network ceased to function. Geography, therefore, played opposing roles in the formation of the fledging Internet; a barrier to overcome for the parts, but yet an asset to utilize for the effective operation of the whole.

While the ARPANET laid the foundation of the Internet, the latter only took off when it filtered into the public domain. Much of this transition from predominantly military and academic applications of the Internet into general use is attributable to the development of World Wide Web in 1993 (Reid, 1997). This interactive medium coupled with growing commercialization and rising popularity of personal computers captured the imagination of businesses and individuals alike. The Internet afforded access to geographically scattered collections of data, information and resources. Today, examples like the call by Hans Lombardo (1999) for businesses to leverage the power of the Internet to fast-forward Asia's economic recovery attests to the rapidity of its growth and its importance in our lives.

3. The Internet and Geography

Soon, if it has not already, the Internet will affect our lives to a greater degree than any other technological development. One of the profoundest effects of the Internet is the modification of our accepted understanding of geographical concepts. It is equivalent to the opening of new horizons when the ideas of Renaissance thinkers superseded Plato's version of a flat earth. To understand the impact of this change in how we relate to geography, one must analyze the effects of the Internet in the way we conduct our lives. The Internet's impact on the sociopolitical and the economic realms can provide us with clues to the evolution of spatial concepts and how we employ these new ideas into our world-view.

Perhaps the most visible application of the Internet is in the business sector. Once, when business cards were the norm, today, web sites are a must for commercial survival. Electronic commerce is accelerating credit card transactions and hastening the demise of paper money transactions. Electronic trading is also changing the face of the stock market. Indeed, much of the tremendous growth in stock values is centered on the high-tech industry. Despite recent leveling off of Internet companies stocks, investors are preparing for higher gains in this industry. The offshoot of conducting businesses online, with the attendant online banking, is that geographic locations of neither the customers nor the sellers are of importance. Of greater concern is the security with which such transactions are conducted. Therefore, access to the Internet is beginning to replace specific locations as one of the primary factors for effective business.

The global coverage that telecommunication conglomerates are seeking to provide the individual, together with new technological aids such as the Wireless World Wide Web (http://www.w4.org/), allow business transactions to be conducted from variable locations. It also opens a larger customer base that companies would otherwise not have access to. The limits of purchasing goods and services used to be bounded by the physical distances between the producers and the purchasers. The Internet relocates these limits, especially when such goods and services can be accessed via the Internet. For example, computer software can be ordered, paid for and be delivered via electronic means, without the need to leave the comfort of one's home.

By that same token, the Internet also allows certain industries to decentralize from office spaces to home offices. Telecommuting, virtual teams, flexible work plans, and temporary professionals are becoming the new workforce in the Internet era. Large, multi-site global companies in information-rich industries are taking advantage of transboundary professionals to complete tasks at faster and cheaper rates than using in-house staff. Ogden (1995) wrote how the first of these virtual employees were British software developers who offered their services to companies based in the USA at half the latter's rate. The question that arises then is whether traditional geographical models of economic activities can explain the Internet model of production and distribution.

As more people are exposed to the Internet, their spheres of interaction expand exponentially. The Internet serves as a megalibrary of not only data and information, but also ideas and groupings. Where once the physical distances limited users in exchanging ideas with others of like mind, Internet connections in the form of chat rooms, newgroups and forums allow new and virtual communities to evolve on the Internet. These communities cut across national borders and social background. The unifying theme is shared concerns and interests. The notion that networking is a crucial strategy for survival underlies virtual communities that are preparing for Y2K.

The ability to conduct a dialogue, be it via electronic mail, newgroups or other forms of electronic communication, imply a sharing of ideas and consensus building. Coupled with the possibility of working from home, the Internet alters our traditional thinking of neighborhoods, communities and societies. On the one hand, the Internet can create groups that cross political boundaries, social status, educational background, gender differences and age gaps. This can be seen especially when individuals spanning the globe come together on environmental and human rights issues. On the other hand, the Internet can also foster closer ties within local neighborhoods, where people living within a given area establish a common forum to exchange and discuss issues that concern their immediate surroundings. The San Francisco Bay Area Net is one of the earliest example of this. So, how can one understand this inherent paradox in the forming of communities on the Internet? Does this call for a rethinking of social theories and geographical concepts of how communities form and function?

These are important questions, because the Internet is fast growing into a global community. With the forming of any community comes the idea of political grouping. Given the trend that location, and hence place and space, are becoming secondary concerns in the economic arena, and the rise of virtual communities in cyberspace, one must raise the question of the new form of governance that the Internet heralds. Already, the absence of territorial boundaries on the Internet poses difficult questions in formulating and implementing rules and laws for Internet interactions. Consensual behavior such as "netiquette" can only take us so far. The seemingly anarchical terrain of the Internet allows rampant fraud, copyright infringements and defamation. Territory based laws of sovereign states need modifications if they are to serve the citizens of cyberspace. The key to this is to recognize that the Internet is a new form of space with its own boundaries and territories. Its citizens will need to be represented and heard in a newly created political framework if the Internet is to remain a domain of democracy. Traditional geopolitics must recognize the growing importance of "netizens" to resolve international issues such as those in the Middle East and Kosovo.

4. Conclusions

Given the far ranging impact of the Internet on society, we need to look at traditional space in a different light. While we are still rooted in the physical dimensions, our interactions with others, be they for social, economic and or political purposes, will increasingly take electronic forms. In line with this progression, our spheres of interaction will extend from the physical limits of commuting, to the near instantaneous and globally ranging telecommunication form facilitated by the Internet.

One form of the new geography will focus on spaces and locations created by expanding telecommunication and Internet connectivity. Telegeography has been put forward as one alternative (http://www.telegeography.com/). While the purpose of this discourse is not to promote any organization, the focus of Telegeography, Inc. raises an interesting question. They define telegeography as the study of telecommunication geography. One of the areas covered by telegeography is the mapping of places and spaces created by telecommunication. The Internet represents, perhaps, the most defined medium of such places and spaces. While statistics and analysis of traffic and proliferation of connections abound on the Internet, studying this growing network from a geographical perspective is still in its infancy.

The key question deals with the choice of paradigms in studying the Internet. The over bearance of technical and quantitative methodologies in understanding the Internet ignores the rich range of approaches available for researchers when studying the rise of this phenomenon. The challenge is to use these approaches in meaningful ways when examining the Internet. Three avenues present themselves when dealing with the Internet; one can use existing paradigms and methodologies, modify them to suit the unique characteristics of the Internet, or strive to develop new models to explain the Internet.

The explosive rate of networking and establishing Internet connections around the world creates a new concept of space that is both paradoxically dependent and yet independent of physical location. Traditional models of geography offer different ways of measuring space, among them the notion of distance in terms other than the physical. Such concepts can be applied successfully to the Internet, but the key issue will be the selection of appropriate indices to measure Internet space. Will focus on the Internet infrastructure yield such indices? Will measuring interconnectivity on the Internet in terms of bandwidth and routers be sufficient, or will new indices than assess the value of content at web sites form the basis for understanding space and place on the Internet?

There is an urgent need to understand the geography of the Internet and how it affects the growing numbers of users. The challenge therefore is to develop acceptable methods of studying the geography of the Internet. History shows that links with physical location determines the rise and fall of civilizations. Geography has, and will continue to play, a crucial role in shaping human ideas and societies. It also plays a powerful role in establishing states and nations, and has been one of the causes for much of human strife. Understanding the geography of the Internet and its hold on its users will prepare us to adapt and function in the ephemeral locations of cyberspace.

5. References

ABCNEWS (1998). The Island at the End of the Internet, Tristan da Cunha Logs On. http://abcnews.go.com/onair/worldnewstonight/general/wnt981013_TristandaCunha.html (13 Oct. 1998).

Gilster, P. (1993). *The Internet Navigator.* NY; John Wiley & Sons.

Lombardo, H (1999). Earning profit from the Internet during Asia's crisis. http://www.internetnews.com/intl-news/article/0,1087,6_68831,00.html (16 Feb. 1999).

Ogden, F. (1995). *Navigating the Cyberspace: A Guide to the Next Millennium.* Toronto; Macfarlane Walters & Ross.

Reid, R.H. (1997). *Architects of the Web.* NY; John Wiley & Sons.

Classifying Virtual Environments - Some Implications for the Mass Market

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Abstract: This paper first presents a classification for virtual environments (VEs). All relevant features of a VE are characterised and classified. The result is a multidimensional metric enabling designers of virtual worlds and corresponding applications to position their systems and to rate the appropriateness of the design in the context of a specific target environment. An application of this classification for a real-world application for the mass market is described. This application is based on a highly flexible VRML generator architecture and covers quite a large region in the multidimensional space of the metric. Since the application addresses the end-user (private consumers or small enterprises) certain constraints in terms of system environments and users' VR-experience had to be considered. Finally the application is rated and positioned in the taxonomy and the process of rating is described in detail resulting in an assessment of the rating system (the classification) itself.

Introduction

Virtual Reality (VR), today called more apt 'virtual environments (VE)', becomes more and more common in modern applications. The confusion concerning the term VR/VE is just one indicator for the upcoming problems with this new form of human-computer interaction. The meaning of the word is anything but clear, despite the fact that it is used frequently.

In this paper a qualitative (and partly quantitative) metric for the numerous aspects of systems using VR-technology is proposed. No exact definition of the term 'Virtual Reality' or 'virtual environment' is given. Rather a multidimensional space into which the reader may put his/her applications in their proper place is defined. In addition, the paper describes a system which uses a wide range of possible instantiations in this space, in order to give the user the most appropriate form of interface in several situations.

A multidimensional classification

This section describes a metric referring to a number of more or less independent features which nearly all VEs have. These features have been selected in such a way that they can be measured or at least estimated and thus can serve as axis in the multidimensional space formed by the classification. After a brief description the individual features a are ordered in relation top each other using a proposed categorisation according to their relevance and independence.

Degree of immersion: Immersion is one of the key features of classical virtual environments. Since immersion is defined as the feeling of being part of the scene, it is difficult to measure this 'degree'. A few attempts have been made to quantify immersion, e.g. in [Kalawsky 98], [Louka 98], [MacKenzie & Booth 96]. A completely different way of looking at this aspect can be found in [Kurze 98]: here the attempt to reach immersion (in the classical meaning of the word) is rejected and the user remains *outside* the scene while he controls a 'puppet' which is a part of the scene (in this sense the puppet is 'immersed').

Capability for users to move/navigate: According to a common saying 'in virtual worlds nobody walks around, everybody flies'. This is only partly correct: While the technology enables users to navigate in numerous ways (walk, fly, jump, beam, ...) some applications limit this freedom to a subset suitable for the specific context in which the application takes place (see below for an example). The capability to move can be set to any value on an axis ranging from 'no movement at all' via 'viewpoint hopping' to absolute freedom with no limitations, enabling flying through walls etc.

Model-complexity: This is a more technical property and should be easier to measure. There are at least two independent aspects that can be identified:

> *Geometric complexity:* Geometric complexity can be defined as the number of vertices/polygons/triangles in the scene. However this number is often hard to tell because modern rendering systems accept complex geometric objects as input (like spheres and cones), and do the polygonisation by themselves. Thus the number of vertices can vary from system to system and even within the same system from situation to situation. Still geometric complexity is a relatively good candidate for an axis in our metric.

Textural complexity: The number and resolution of (image or movie or procedural) textures. Textures and in particular image textures need display memory to be rendered. Hi res images and movie textures require not only this memory but also a lot of computational power to map the appropriate picture/frame on the geometric object. Texture co ordinates are used here and add further necessary effort.

Motion/Animation: Objects in VEs can be static like houses, or they can be animated like moving cars, birds and so on. Motion attracts the visitors' eyes, and motions make the scene look vivid. Therefore motion is a valuable tool in VEs. On the other hand motion requires a lot of resources: Not only must a rendering engine be able to draw objects at a different place or in a different position, but moreover the designer of a virtual world must not only design the object itself but also its' animation path.

Interactivity: Interactivity is *the* main feature that makes the difference between an animation and a virtual environment. Without interactivity, a 3D world would be like an old-fashioned museum and in fact its' contents might be better to present in conventional 2D fashion. The most basic form of interaction is user navigation. In our context user navigation (e.g. walking) is not considered as being interactive even though the user can choose the way of perceiving the environment by selecting the path and speed at will. This form of intra personal interaction (the user acts and perceives changes on which he reacts, but these changes are caused only by his perceptional process) would be interesting to explore in more detail, but it is not covered by the present definition of interaction which requires the environment to be active itself. Three forms of interaction can be distinguished: Interaction with objects like buttons or door handles, with other users and with applications outside the virtual environment.

Interaction with objects: This is the most basic form of interaction in virtual environments. Objects like door handles are supposed to be interacted with, even in the real world. Other objects react on the user's actions in a different way than in the real world: Often you can touch a whole object to make it act, this is true for doors too: The door's geometry can be set to react on a touch (i.e. mouse click) by opening (or closing). Very often arbitrary shape react on touch events which cause it to start an animation sequence. (That's why people move the mouse over objects: They want to make them move).

The trigger for objects actions, i.e. re actions to the user's actions, can be nearly everything: from the time the user is present in an environment to the "enter" event of a proximity sensor, even the state of the user (his/her history of behaviours in the environment) can be used as a trigger. In many cases it is difficult to model "natural" behaviours of objects that the user can interact with only by using a pointing device, thus other forms of interaction are used.

Interaction with other users: The basic form of interaction with other users in a virtual environment is communicating. This communication can be performed using gestures or text (spoken or typed). Adding multi user functionality to a VE results in a huge number of nice options and at least as many potential (conceptual) problems: The other users avatars (3D representants) can be regarded as objects in the VE, but they must be kept consistent in all its instances. Only one user can control this avatar, the other can only observe it (or interact via pre defined interfaces). An other problem (and an opportunity) are shared objects: What does a user see if an other visitor opens a door (in what way ever). Can a user pass an object to an other user? How is this performed? As indicated, the multi-user concept is worth a more detailed investigation which can not be accomplished here.

Interaction with other applications: Finally, VEs often are used as the front end of other applications, sometimes more than one at a time. Thus, a VE might be able ore forced to interact with other applications. These other applications can use the VE as the user interface or they may have their own GUI. Even combinations are possible. The interaction (e.g. a shopping-task in a 3D store based on a conventional E-commerce application) is done in both applications in parallel. Sometimes the trigger for an action in the VE is released by the background-application without a user's interaction. This can cause confusion if the action results in disappearing objects (e.g. if a desired and currently explored item from a store is out of stock an thus removed from the display). However, it is possible and thus must be considered in a classification covering as many options as possible.

Frame-rate: The frame-rate is very important for a reliable interaction in VEs. Thus this unit for speed must be considered here. Unfortunately, the frame rate is not an independent dimension. Rather it depends on the rendering environment (hard- and software) and on the geometric complexity of the scene or parts of the scene. A number of procedures can be performed to keep the interaction and movement in VEs smooth.

Communication: Communication is in many aspects similar to interaction. In fact one could assume that communication is a special case of interaction where only information is exchanged and no task is performed. Like interaction, communication can take place between users (visitors) of a VE, between users and objects (e.g. bots) and between the VE and other systems (see [Rea 98]). This paragraph will concentrate on the latter. After a VE has been loaded into the users browser, it can contact other systems such like an external server to get additional information or even new elements of the VE. This communication often depends on the users actions, e.g. his path through the VE. The number of communication events and their intensity (the amount of data transmitted) directly interferes with the smoothness of the VE and with its start-up time: A world can be first loaded in a rather coarse version and then be updated on demand, or it can be downloaded more or less as one big chunk and is then available immediately. Both variants have their advantages. This dimension in our taxonomy is closely connected with the next one, network bandwidth.

Network-bandwidth: This is always a critical issue. You can never have enough. One of the most charming features of VEs is the flexibility in terms of required network bandwidth. You can build a nice VE with just a few lines of code resulting in just a few bits to be transmitted over the network. On the other hand you can use all the bandwidth available for high quality sounds and/or movie-textures. Thus network-bandwidth is not just one dimension in the metric, it covers two: The *flexibility* of a VE to use a range of available bandwidths must be considered separately.

Addressed sensory channels: These dimensions of the metric rely completely on the available devices (hardware). Naturally the software must support the devices/channels to create the desired perception. The particular channels are listed below:

> *Video/Sight/Stereo-Vision:* The sense of sight is the main perceptual channel for most people. For virtual environments, a large portion of the field of view should be occupied by the visualisation of the surroundings. A monitor should be able to display as many colours as possible at a high resolution, possibly in stereo (one display per eye). Fortunately, the eye can be cheated more easy than the ear, thus a poor visual quality is often accepted by humans.
>
> *Audio/spatial audio:* Do the worlds contain audio, and are the sound sources detectable in 3D-space? How many sound-sources are supported? Which formats of sound (sampled sounds/midi/synthetic speech/ ...) can be used?
>
> *Haptic/touch:* This channel is receiving more and more attention in the VE community since the lack of tactile feedback and haptic stimulation in most VEs today is prevents these VEs from being as effective as possible.
>
> *Taste and smell:* These are still not used at all in VEs. Only a few attempts have been made to add odour to certain objects in VEs. An enormous effort is necessary to do so, and the results are very limited. In addition the usability of smell devices is not very high: you can not turn odour off immediately and you can not stop your own olfactory sense at will.

Origin of the VE: In business uses, it is of great importance that VEs are generated automatically from a database or other sources and not generated manually. Thus the VE must be designed once in a way that a particular change in the requirements (or in the database) can be reflected automatically in the VE. This requirement can collide with the multi-user aspect: since in a multi-user VE the world must be identical for all users, it cannot be generated freshly for each new visitor. Other implications follow from this problem.

Appearance: Finally the appearance of the VE can be different from one instance to the other: The world can look very much like the real world or a real city/house/room as in [Distler 98]. Or the VE can be a futuristic spaceship looking different than all those spaceships the user might have seen before. Eventually the world can be completely abstract with no items that can be referred to as "rooms" or buildings (see [Feijs & de Jong 98]). This is a matter of design and depends on the purpose of the VE (and the owner's taste ;-).

Organising these properties

The properties described above span a multi-dimensional space of possible combinations. Before taking a closer look at the interdependencies of these dimensions, the properties/dimensions according to the driving forces that determine the dimension are organised:

Some distinctions between VEs are mainly *technically driven*. These depend on technical conditions such as processor speed, display devices or software-interfaces. Technically driven distinctions are: model complexity, motion/animation, the frame rate, network bandwidth, and the origin of the VE.

Perceptually driven distinctions are caused by the way human visitors perceive the VE. Thus they depend on individual human sensations, actions, and thoughts. So they may be hard to determine in advance. On the other hand, once you understand some basic features of human perception in VEs, you can build much more effective and attractive ones. Examples for perceptually driven differentiations are: degree of immersion, sensory channels, and interactivity.

Finally, *task driven* distinctions can be identified. This is a difficult class of dimensions because it actually covers most dimensions in the metric but they are of different importance for the different tasks to be performed in a VE (see [Ishi et al. 98] for an example). In general business tasks require extremely efficient VEs which do not necessarily have to be nice and entertaining. On the other hand, entertainment tasks should be pleasant to explore while efficiency is of less importance. The capability for users to move/navigate, interactivity, communication, and appearance can be placed into the context of task driven distinctions.

Rating the Classification

The properties which determine the dimensions in the classification are not completely orthogonal (In so far they do not really create "dimensions" in the conventional meaning of the word). Some properties depend on others more or less directly: e.g. the model complexity directly influences the frame rate (the more complex the model, the lower the frame rate); these are both technically driven distinctions. If the frame rate is very low the user cannot perceive a real feeling of immersion (a perceptually driven distinction). Immersion plays an important role in some professional tasks (e.g. judging a new cars interior). Thus a high model complexity might prevent the user from judging a car interior presented in the form of a VE from being effective in his/her task. A naive person could now come to the conclusion that a reduced model complexity might increase the frame rate and thus make the task more easy to perform. This would be anything but effective: judging a car interior requires a very high accuracy. Otherwise the results of the observations would be useless.

The relevance of the different dimensions varies widely in different tasks. So the task-based differentiation may be the most important in the described classification. Having said this, one can continue by stating that there is an order of importance for the different dimensions. As mentioned above, interactivity plays a very important role among the features that constitute a virtual environment. Unfortunately the classification in the form described here does not reflect this factor appropriately. This is due to the fact that "importance" is an amorphous property which depends on the given task to a certain degree.

The usefulness of the taxonomy has been tested in a real-world implementation. A framework for software integration and a common user interface to make this software accessible utilising an intuitive navigation support has been developed.

Implications for the implementation

The classification described above has been used to design and implement a large-scale virtual environment for the mass market. The objective of the design project was to develop a 3D environment hosting a conceptually unlimited number of service domains which in turn are represented in 3D as well. The services to be included in the framework were highly inhomogeneous and the requested levels of integration ranged from a simple web-link to a complete merger. The following section covers these and other aspects of the problem and shows how the classification helped to keep the individual aspects in order. These (and other) constraints forced us to pick particular areas in the n-dimensional space set up by our metric.

The target group of users was inhomogeneous; therefore the application had to be highly adaptive (or adaptable if adaptivity could not be reached). The intended users were mainly private people ("consumers") using their PCs at home. Since the service domains included (among others) a set of games, a video on demand (VoD) shop and a more conventional shop offering telecommunications devices, children, possibly experienced arcade players, and adults with only a limited experience using a PC or 3D interaction had to be addressed (and reached). In addition a special version of the application was needed for small and medium enterprises (business users).

The target platform was not specified precisely; therefore a platform independent solution had to be developed. To maintain platform independence, it was decided to rely on international standards, mainly HTML and VRML. Unfortunately there are at least two major HTML Browsers and at least three important VRML Plug-Ins for them. All these systems cover a big portion of the standards, but there are important differences between them which prevent a working solution that runs on every combination of browsers and plug ins. Finally, the graphics card in the PC (in particular if it supports 3D acceleration such as Open GL or Direct-X) must be considered. Even if the 3D acceleration technique is well defined (as in the cases of the mentioned systems) the drivers of the cards obviously interpret these definitions at will.

Using a participatory approach complemented by extensive semiformal usability testing and quality-management several versions of the whole system were implemented. At least three stages were frozen and presented to a bigger user group for testing purposes. Finally a combination of "classic" VR, conventional 2D-Webpage, conceptual visionary and cognitively inspiring 3D animation with vivid and experience-oriented elements was implemented.

In addition to the 3D *world* based approach the same technology was used to develop an application that actually *is* 3D even though it *looks* two dimensional in most situations. Here the fact that VRML worlds have a state and a progressing time and allow a lot more interaction with the user than traditional 2D HTML sites was exploited. Only in one situation the spatial nature of the whole application becomes clear: When the user selects a real object (in our case a phone), regularly the application provides a convenient access to a complex set of forms in a business centre.

Figures 1 to 4 show some screenshots of different versions of the application. To make a comparison possible, similar scenes have been chosen in all VEs. The whole application has a lot more to offer than can be seen here.

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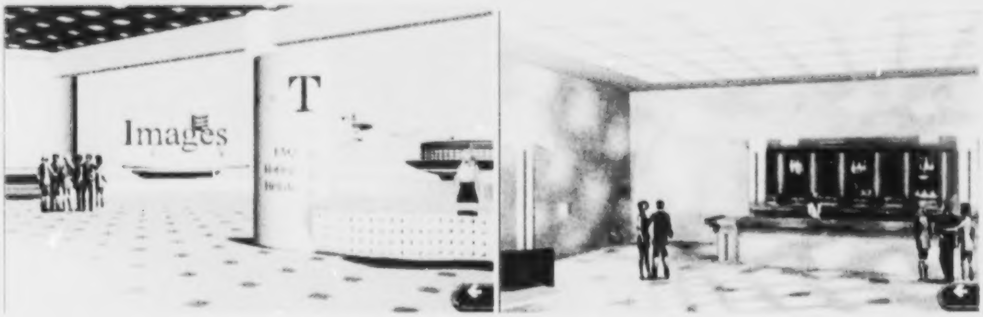

Figure 1: Version 1 of the application: architectural appearance, high geometric complexity, limited interactivity

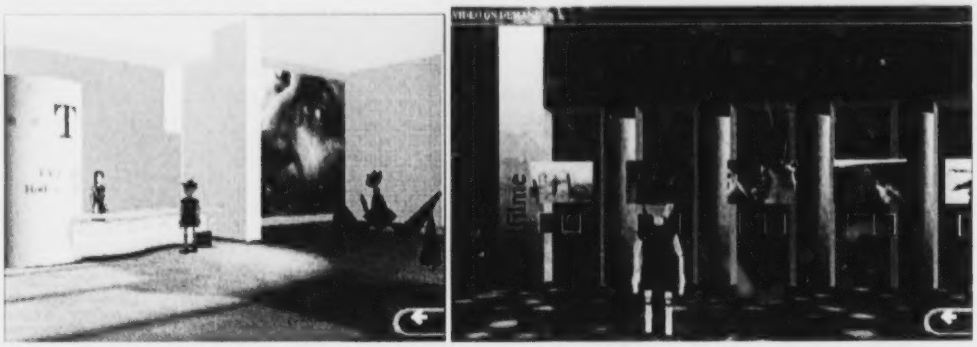

Figure 2: Version 2 of the application: medium geometric complexity, high interactivity and communication; the screenshot on the right shows

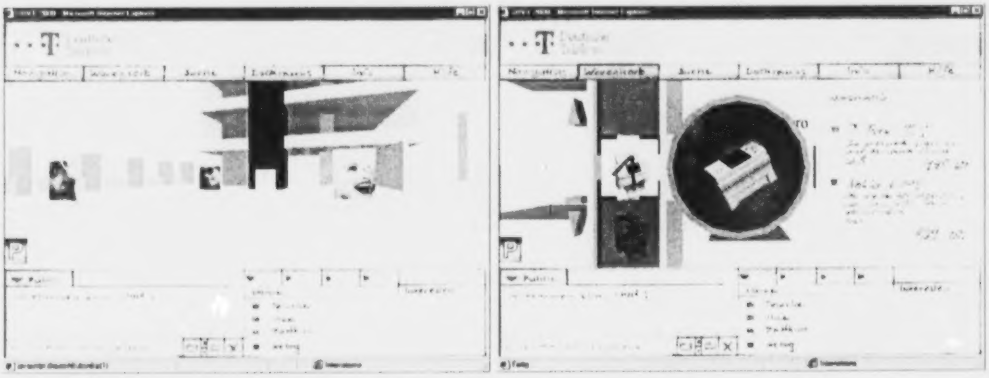

Figure 3: Experimental version 3 of the application: partly abstract Environment, low bandwidth requirement, highly interactive potentially multi-user, integrated 2D-components.

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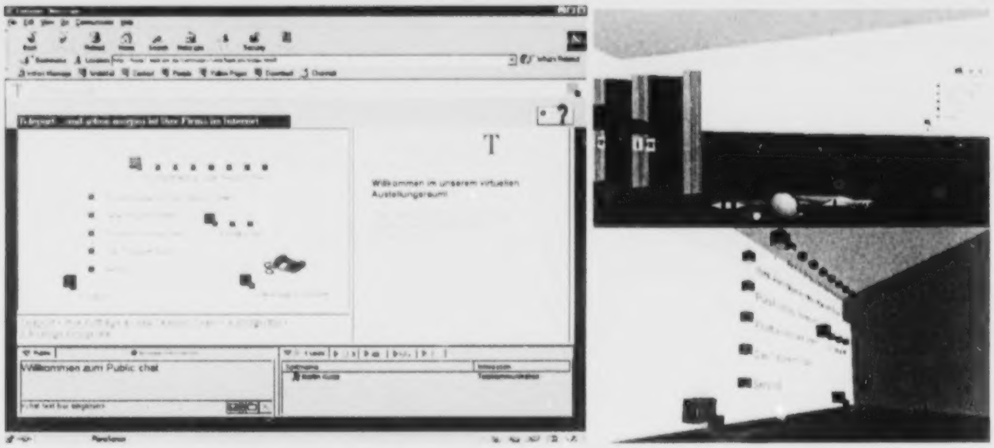
Willkommen in unserem virtuellen Ausstellungsraum!
Willkommen zum Public chat

Figure 4: The application in the business centre context: The scene might look flat (left) it is three dimensional which can be seen (bottom right) once the viewpoint changes to show 3D-objects (phones, top right).

Conclusions

Due to the multidimensional taxonomy for virtual environments described above it was possible to determine the positions of the individual instances of our VEs. A sort of similarity and relationship among these applications could be maintained. This reduced the development work for all these systems very much.

Concluding this paper it can be noticed that a classification for VEs is a valuable tool to organise design and implementation work. It makes various VEs comparable and thus uncovers similarities between them which might not be discovered otherwise.

Working with our classification also showed us that the metric is not yet perfect. In particular the number of dimensions seems to be quite high and thus makes working with it difficult. The categorisation helped a lot, but there still remains a lot of work to localise a planned VE or to find out what to change to make it appear at a specific spot in the multidimensional space.

This leads us to the future work that will be performed now: First the classification will be revised and the number of dimensions reduced or grouped differently. A tool to make the localisation of a VE easier will be developed. In parallel to these activities the classification and the rating process will be applied to other VEs found in the VE community.

References

H.K. Distler (1998). Navigation in Real and Virtual Environments: Navigating a Virtual Landscape. *Proc. Virtual Environments 1998*, 16-18 June 1998, Stuttgart, Germany; Eurographics Workshop Proceedings Series.

Loe Feijs & Roel de Jong (1998). 3D Visualization of Software Architectures. *Communications of the ACM* December 1998/Vol. 41, No 12.

H. Ishi et al. (1998). A study on Design Support for Constructing Machine-maintenance Training system by using Virtual Reality Technology. *Proc. 7th IFAC/IFIP symposium on Analysis, Deign and Evaluation of man-Machine Systems*, Kyoto, September 16-18, 1998.

P. Rea (1998). Experiences from an inhabited Television Experiment, *Proc. Virtual Environments 1998*, 16-18 June 1998, Stuttgart, Germany; Eurographics Workshop Proceedings Series, ISSN 1024-0861

R. S. Kalawsky (1998). Exploiting Virtual Reality Techniques in Education and Training: Technological Issues. Report for AGOCG; http://info.mcc.ac.uk/MVC/SIMA/vrtech/title.html

Michael Louka (1998). An Introduction to Virtual Reality; Ostfold College, 1998 http://w1.2691.telia.com/~u269100246/vr/vrhiof98/index.html

Christine L. MacKenzie, Kellogg S. Booth (1996). Workshop on Manipulation in Virtual Environments; *CHI '96*, Vancouver, Canada.

M. Kurze (1998). The Puppet Approach – A Metaphor for Non Immersive VR Interfaces. . *Proc. 7th IFAC/IFIP symposium on Analysis, Deign and Evaluation of man-Machine Systems*, Kyoto, September 16-18, 1998.

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Towards User-Specific Navigation Guidance on World Wide Web

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Abstract: The *Computer Aided Information Navigation* project provides a new method of adaptive navigation support which aims to increase the World Wide Web's value as a pedagogical tool. This work approaches adaptive hypertext systems, metadata, computer supported co-operative work and recommender systems. The project extends and combines work from these areas in a new way to support learning and initial research tasks by facilitating the navigation process, providing a Rough Guide-like weak hypertext linearization which enables the user to follow a ranked sequence of selected, context specific, World Wide Web pages. This is accomplished by regarding information available on the World Wide Web as an open corpus upon which a new specialized structure is superimposed which provides for a collaboratively built partial representation of the World Wide Web's information space and which also provides a mean of representing user attributes.

1 Introduction

A large volume of information, such as the one available over the World Wide Web (Web) has an inherent application potential in an educational setting. Unfortunately, besides inheriting and enhancing most of hypertext's qualities, the Web also incorporates and stresses common hypertext problems. It is the Web's disorganized nature that mainly prevents its most effective use as a pedagogical tool and, as such, research is needed to develop the means that will help to transform the available data into meaningful information able to support learning or initial research activities.

The *Computer Aided Information Navigation* project (*CAIN*), reported in this document, attempts to provide adaptive navigation support as a way of increasing the Web's value as a pedagogical tool. *CAIN*'s approach is a reactive one as the effort goes into providing a way to deal with the vast amount of useful information available on the Web as is, rather than to try to improve or alter the Web's infrastructure in any way.

In order to help users reach their goals, *CAIN* provides direct guidance navigation support as a form of non-obtrusive *weak hypertext linearization* enabling the user to follow a context specific ranked sequence of selected Web pages without ever needing to perform any search or follow any link if they do not wish to. This approach does not intend to prevent goal-oriented exploration but to provide a sound thread or guideline to help users to retain their focus in the way a *Rough Guide* does.

The system's representation of the Web, crucial to the success of its adaptive features, builds on the *Dublin Core* and on the *Resource Description Framework* (RDF) (Lassila & Swick, 1998). The users' representation combines three user modeling techniques resulting in a hybrid solution that uses stereotypes, overlays and attribute-value pairs.

Navigation support is accomplished by a basic route-finding heuristic which selects context specific Web model items, sorts them using associated qualitative ratings and presents them to the user, one at the time, based on the attributes of the user's model.

Section 2 presents and discusses the problem space, section 3 provides an overview of the related areas of research and section 4 presents the project outline. Finally, section 5 provides final remarks and highlights future research directions based on the work done so far.

2 Problem space

The Web affected and affects the *modus operandi* of many people in areas that range from scientific work to business, including education, and Web usability problems affects many users today (Brown, 1990; Shum, 1996). The fact that the Web is currently perceived as an accessible medium in which anyone can create content results in a community of developers where the majority of authors are new to system development and have little or no knowledge or understanding of human-computer interaction issues.

Further, poorly designed hypertexts are also cited as a problem source (Brown, 1990) since, just as early programmers lacked experience, so do the majority of current Web authors. The consequence is that many Web sites are developed by multiple authors with different goals which tends to result in incremental expansion of their information space without coordinated planning.

2.1 Setting the boundaries

Before focusing on the problem and outlining its context, two questions raised by Theng (1995) must be discussed: are we looking for solutions to an avoidable problem? what if we do the right thing from the start?

These questions defend the position that, when talking about hypertext navigation, most of the effort on the system side is a reactive approach, ie most of the effort goes into providing solutions to problems that result from badly designed hypertext. From this point of view, it is suggested that feasible approaches to avoid or minimize navigation problems include (Theng, 1995): incorporation of good design principles and guidelines; and defining the task and structure of the hypertext applying a user-centered design methodology;

This position is further defended by Berk & Devlin (1991) who argue that the continued emphasis on navigational difficulties is leading to too much attention being given to navigational tools while insufficient attention is being paid to what constitutes good hypertext writing. This point of view is somewhat supported by recent studies reported by Furnas (1997).

The approaches to the problems of navigation and information overload can thus be summarized in two perspectives: *Top down approach* - where the problem is perceived from the reader's stand point and solutions seek to help improve navigation tools to cope with information overload. These include better browsers offering more navigation facilities, better search engines and additional navigation tools such as agents and mediators; *Bottom up approach* - where the problem is seen from the content provider point of view and approaches seek to provide better content layout and improved structural support. These include enhanced authoring tools and improved hypertext system infrastructure.

Nonetheless, even if the *bottom up approach* was shown to be the better one, the fact that there already exists a huge amount of information ready to be accessed and used justifies all the effort invested in pursuit of better, system side, navigation aids. More, an environment such as the Web, in which every reader is potentially also a Web author, makes it very difficult to enforce any author-side methodology or set of guidelines.

2.2 Setting the context

As said before the Web's volume of information has potential application in an educational setting, but its disorganized nature prevents its most effective use and research is thus needed to develop technology that helps to transform the available data into meaningful information as part of a learning or information-retrieval activity deployed either individually or in a collaborative way (Eklund & Ziegler, 1996).

Using the Web as a pedagogical support can be achieved in two, nonexclusive ways (Marshall, 1995): *Closed corpus* - in this case, the technology is mostly used for its hypertext and distance delivery capabilities and, normally, specially designed content is provided; or *Open corpus* - This approach takes advantage of the large quantity of information available on the Internet whether or not it has been developed for educational or training purposes. In this case, however, an organized structure, static or not, must be superimposed over the addressed information space to enable guided or assisted information explorations which would not otherwise be possible due to the generalized assumption that information producers are mostly passive and that it is part of the reader's role to drive the process.

As suggested by Eklund & Zeigler (1996), applying the results of the research in *Intelligent Tutoring Systems* or *Computer Aided Learning* to the Web, either in *closed corpus* or *open corpus* approaches, is a logical step and is reflected by ongoing research on *Adaptive Hypertext Systems* (Brusilovsky, 1996), a research area which has its roots in *Adaptive Systems* research (Benyon & Murray, 1993). Other researchers (de La Passardiere & Dufresne, 1992; Jonassen, 1992) go even further suggesting that some expert assistance or guidance in the form of, for example, individualized navigational advice, could provide more structure to the information space and more direction for the user as an approach to minimize disorientation problems and prevent readers from becoming lost, skipping important content and looking for visually stimulating rather than informative material.

Nonetheless, evidence exists that the data navigational and structural tools currently available are not sufficient to exploit the available information (Andrews et al., 1995). Additionally, learners tend to make poor decisions in learner controlled systems and, therefore, some direction or knowledge sequencing might be necessary for the World Wide Web to become an effective learning environment.

2.3 Subjects addressed in this work

One way to provide such direction is through the use of adaptive navigation techniques used in some hypertext systems and identified by Brusilovsky (1996) as being able to provide features including direct guidance, adaptive annotation, and adaptive link re-reordering and hiding.

However, in order to enable adaptive navigation, apart from modeling the user, information must be available to the system about the underlying information space.

lated areas

As closely related subjects, adaptive hypertext systems, metadata, recommender systems and computer supported cooperative work are summarized in this section.

3.1 Adaptive hypertext systems

Adaptive hypertext systems build on the general adaptive system's concepts but there are a number of considerations to be made. Such systems cater for users with different goals and knowledge who may be interested in distinct pieces of information and links contained within a hypertext node. In general, an adaptive hypertext system attempts to overcome this problem by providing either adaptive presentation or adaptive navigation support or both (Brusilovsky, 1996). *CAIN* only provides direct guidance but different alternatives include adaptive sorting of links, adaptive hiding of links, adaptive annotation of links, and map annotation.

Adaptation goals are dependent on the application areas as each application addresses its own set of problems and each goal is only relevant within some specific context. They also usually provide or drive the answer to the *what should be adapted* question. User model features usually include features related to the current application context and to the individual user as also happens with other adaptive systems.

3.2 Metadata

Metadata is *data about data* and in the case of the Web, it can be the domain structure and content model needed to enable the adaptive behavior characteristics provided by a Web access mediator such as *CAIN*.

One of the advantages of using a *new* term to describe Internet resources is that there is no residual meaning attached to it as it would be the case with the *catalogue record*.

In *CAIN*, the *Dublin Core* (Weibel & Lagoze, 1997) is used as the underlying metadata definition and the project's domain model builds on its core elements and qualifiers as they are, on one hand, flexible enough to accommodate ratings and a number of other attributes needed to build the domain model and, on the other hand, they are structured enough to enable automated machine processing. Finally RDF (Lassila & Swick, 1998) provides the model for representing Dublin Core's named properties and their values enabling a syntactically independent way of representing *CAIN*'s domain model. RDF features a layered architecture that progressively offers higher level constructs and on top of which the Dublin Core can be defined.

3.3 Recommender systems

Recommender systems assist and augment the activity of making choices without sufficient personal experience but instead based on recommendations from other people (Resnik & Varian, 1997). Recommender systems may be classified on a number of dimensions (Resnik & Varian, 1997) including technical attributes, domain features, user characteristics, the recommendation density, the recommendation consumers, and the consumer goals variability.

In *CAIN* the contents of a recommendation can both mean that a new metadata record was added to the system or that a referred Web node was visited and that the user volunteered a relevancy rating. Additionally, whereas any system user may submit a relevancy rating, only selected users can actually *recommend* a Web page. The main reason for this constrain is to provide some credibility to the cooperatively built Web domain model as, for the system's success, the stored information must be trusted and reliable.

4 Project outline

As a navigation support tool, *CAIN* aims to support the accomplishment of learning and initial research tasks helping users to move sequentially in a given environment taking most of the burden of deciding where to go next off their shoulders *i.e.*, *CAIN*'s goal is to facilitate the navigation process within a specific subject's context when the target is to acquire or improve knowledge about that particular subject.

As also happens with bookform *Rough Guide* users, potential *CAIN* users rank low in either or both *subject knowledge* and *expertise in Web navigation*. From this point of view and to enable adaptive navigation support, the usage of the Web as a pedagogical support is achieved regarding the large quantity of information available as an open corpus over which a specialized structure is superimposed which caters for:

The domain model - A partial representation of the Web's information space; and

The user model - A representation of a given user's attributes.

As said before, the behavior of the adaptive navigation shell provided mainly results from the combination of these two models. Further, the system's design ensures that users can inspect the adaptivity mechanisms and control their results. This approach aims to improve trust and prevent disappointments resulting from misunderstood changes in the adaptive navigation shell (Höök, 1996). *CAIN*'s domain model, contains Web metadata stored as Dublin Core compliant records.

Used Dublin Core elements include *title*, *description*, *resource identifier* and *date* but intentionally exclude the *relation* element. This happens because explicit linking is not needed as the sequence of Web pages is determined on the fly and only selected available nodes are presented to the user as a thread. Specially important are the extensions to Dublin Core's element set used to provide the storage of the contextual and related ratings needed to enable the system's adaptive behavior. Each metadata record can have one or more associated *contexts* and each context has an associated *depth* and *level* rating and one or more *relevance* ratings. These contexts are a key characteristic of the domain model as they provide the frame of reference for specific Web resource ratings. Finally, the depth, level and relevance ratings all have different grades with well defined semantics.

On the other hand, the user model uses an overlay approach to model the user's interests and knowledge as well as attribute-value pairs to record personal data. User models are user inspectable and modifiable and divide users in two distinct groups:

Moderator - Users that can add metadata records, contexts and ratings to the domain model. Moderator status can also be delegated by *moderators* on *readers*; and

Reader - Identifies every other system user. These ones are restricted to just using the navigation aid provided and to eventually submit relevance feedback information.

Stereotypes can be used to initialize the user model and the more general one is the one describing the user as knowing nothing and having no interests what so ever. Populating and maintaining the domain model is a task shared between users and the system and also a collaborative effort as the system relies on its users to collaboratively populate the domain model either by adding new metadata records, contexts and ratings or by simply providing relevance feedback.

Populating and maintaining user models is also a user and system shared task. The user explicitly fills in her own user model when she uses the system for the first time and from that moment on, the user model is updated either:

- Explicitly by the user when choosing a new context or modifying context specific threshold information; or
- Implicitly by the system when providing navigation support and updating a particular context's record of used resources and thresholds.

Combining the domain and the user models to provide direct guidance is a very simple three step process comprised of *context selection*, *route finding* and *determining what to show next*:

- First, the context element of the metadata records enables the selection of specific context related metadata records;
- Then, the selected metadata records are then sorted by level, by depth and by the relevance average. The result is a context specific ordered list of Web resources in which fundamental ones come first, within them general overviews come first and finally, more relevant material comes first;
- Finally, the route for the selected context is compared against the user's model and the first unread Web page is brought to the user and so are all the following unvisited ones.

The proposed solution was formally specified and to test it, a prototype implementation was developed and an initial empirical study was conducted which provided encouraging results. Finally, although *CAIN* aims to support learning activities, it is not an Intelligent Tutoring System as it is not able to diagnose or correct misunderstandings, or to provide an assessment of the level of achievement of the student.

5 Final remarks

This project's reactive top down stand point is, however, not taken lightly because other approaches that tackled the problem from other angles were also considered. However, all the pro-active bottom up alternatives seem to reduce the Web's successful characteristics resulting in either:

A decrease in hypertext production because if strict publication rules were imposed on authors, a percentage of them would stop or at least slow down delivering Web content;

A bypass of publication rules because if authors can still publish without any additional effort some will; or

A complex publication procedure if rules were imposed in some way and control mechanisms implemented.

CAIN's major contributions are the bringing together of different areas of computer science. Although an initial empirical study suggests that the navigation guidance provided improves the performance of its target Web users, the study is not exhaustive and further development and empirical work need to be done.

The above work provides an initial understanding of how individualized, adaptive and directed Web navigation guidance can be provided over contextualized Web browsing experiences. Following these first steps, future possibilities include:

- Improving the Web model and its modeling devices;
- Improving the user model and the user modeler;
- Improving the route finding heuristic; and
- Understanding the system's application boundaries.

Regarding the latter, besides supporting the accomplishment of learning and initial research tasks, other application areas may be explored namely supporting distance learning courses, assisting project groups and providing contextualized enterprise information.

Bibliography

Andrews, K. et al. (1995), Embedding courseware into the Internet: problems and solutions, *in Educational multimedia and Hypermedia: proceedings of Ed-Media 95*, Association for the Advancement of Computing in Education, AACE.

Benyon, D. & Murray, D. (1993), "Adaptive systems: from intelligent tutoring to autonomous agents", *Knowledge-Based Systems* 6(4), 197-219.

Berk, E. & Devlin, J. (eds.) (1991), *Hypertext/Hypermedia handbook*, Book News, Inc., Portland, OR.

Brown, P. (1990), Assessing the quality of hypertext documents, *in proceedings of the ECHT'90*, UK.

Brusilovsky, P. (1996), "Methods and techniques of adaptive hypermedia", *User Modeling and User-Adapted Interaction* 6, 87-129.

de La Passardiere, B. & Dufresne, A. (1992), Adaptive navigational tools for educational hypermedia, *in* I. Tomek (ed.), *Proceedings of the 4th International Conference, ICCAL 92*, Springer-Verlag, Berlin, Germany, pp.555-567.

Eklund, J. & Ziegler, R. (1996), Navigating the Web: possibilities and practicalities for adaptive navigational support, *in AusWeb 96: Second Australian World Wide Web Conference Proceedings*, Southern Cross University, Queensland, Australia.

Furnas, G. (1997), Effective view navigation, *in Human Factors in Computing Systems: CHI 97 conference proceedings*, ACM, Addison-Wesley, Atlanta, GA, pp.367-374.

Höök, K. (1996), "A glass box approach to adaptive hypermedia", *User modeling and user-adapted interaction* 6, 157-184.

Lassila, O. & Swick, R. (1998), "Resource description framework RDF model and syntax [Online]", Available at http://www.w3.org/TR/WD-rdf-syntax/ [Accessed: 9 March 1998]. W3C Working draft.

Marshall, A. (1995), Developing hypertext courseware on the World Wide Web, *in Educational multimedia and hypermedia: proceedings of Ed-Media 95*, Association for the Advancement of Computing in Education, AACE.

Resnik, P. & Varian, H. (1997), "Recommender systems", *Communications of the ACM* 40(3), 56-58.

Shum, S. (1996), "The missing link: hypermedia usability research & the Web", ACM SIGCHI Bulletin 28(4), 68-69, Report on the British HCI group symposium, 1st May, 1996.

Theng, Y. L. (1995), Lost in hyperspace? a look at 4 viable approaches, *in HCI 95 Adjunct proceedings*, UK.

Weibel, S. & Lagoze, C. (1997), "An element set to support resource discovery: the state of the Dublin core: January 1997", *International Journal on Digital Libraries* 1(2), 176-186.

Electronic Education Mall – A Virtual Marketplace for Web-Based Learning

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Abstract: New learning paradigms, the continuous progress in the field of information and communication technology, as well as a stronger commercialization of education and training are relevant pacemakers on the way towards an electronic education market. This article introduces the concept of an Electronic Education Mall (EEM), which supports communication and interaction processes between suppliers and customers in this market. The EEM can be regarded as a virtual center for educational services, which facilitates market transactions by providing a multitude of service functions.

1 Approaching an Electronic Education Market

1.1 Status Quo

Due to continuous progress in the field of information and communication technology, not only companies but also universities in particular are facing new challenges and opportunities. Universities, e.g., have now more opportunities to cooperate with the industry and other educational institutions. At the same time universities' programs and courses can be targeted at new groups. As a consequence there will be an increased market orientation: "We have entered the era of world wide competition among institutions of higher education. In the long run this will also apply to public and private education at all levels and various student services" [Turoff 1999]. In this context universities are trying to open up new financial sources by offering specific media-based learning materials to non-students.

Specific support systems (videoconferencing, groupware, authoring tools, etc.) provide the platform for innovative forms of teaching and learning. Media-based learning resources (MBLRs) directly or indirectly accessible and applicable via the Internet/WWW cover integrated Web-based courses, Web-based information and knowledge pools, electronic references, electronic learning materials (e.g., PowerPoint slides), conventional Computer Based Training (CBT) applications, as well as various forms of synchronous and asynchronous teleteaching/telelearning applications.

1.2 Closing the Gap between Suppliers and Customers

Today there is a myriad of producers and, accordingly, of MBLRs they offer on the WWW. Prospective learners are often faced with the serious problem of having to pick out the right contents out of the enormous supply of MBLRs on a specific demand. Up to now, support provided by the suppliers (content providers) has been insufficient. A study conducted by the University of Erlangen-Nuremberg among about 120 German suppliers of Web-based learning resources revealed that basically only few sub-processes of a transaction between supplier and customer – in most cases parts of the information phase – are supported electronically. None of the suppliers surveyed provided continuous electronic support of all transaction phases, which according to [Schmid 1993, 468] is one of the crucial criteria of an electronic market.

Consequently the coordination of supply and demand on this electronic market for education and training remains a true challenge. In other business sectors structures of electronic markets have already emerged, e.g., electronic stock markets, or computerized reservation systems in the tourism industry.

Accordingly, in the field of education and training the development towards an electronic market seems possible (cf. [Hämäläinen, Whinston & Vishik 1996]). Flanking developments in electronic commerce (cf. [Kalakota & Whinston 1996]) are expected to force and shape the establishment of an Electronic Education Market.

One important issue is how to design and support coordination and cooperation activities in this Electronic Education Market appropriately. A promising approach is the development of so-called Electronic Education Malls as an analogy to electronic shopping malls. A concept for an Electronic Education Mall (EEM) in the sense of a coordination instrument in an Electronic Education Market is introduced in the following chapters.

2 Concept of an Electronic Education Mall

2.1 Characterization

Systems supporting coordination, cooperation, and transaction processes within an electronic market have to provide a multitude of services. In addition, standardized interfaces for suppliers and customers are needed. Internet/WWW-based electronic (shopping) malls are an approach to fulfil these demands. This leads to the derivative concept of *Electronic Education Malls* for educational contents and services, which provide a technological platform with appropriate value-added services and interfaces for suppliers and customers.

In this sense an EEM can be regarded as a *virtual service center for educational purposes* [Langenbach & Bodendorf 1998a, 290]. An EEM can be built up by a coordinated alliance of service providers within the Electronic Education Market. Concrete examples for those service providers are *certification and quality assurance authorities, marketing units, education brokers, advisory boards, accreditation authorities, technical providers and financial clearing units*. The services provided by this alliance are accessible through a standardized system of *Mall Services*.

Particularly, regarding the establishment of an EEM analogies to virtual corporations/organisations (cf. [Byrne 1993], [Mowshowitz 1997]) can be identified. One possible approach is to set up a fixed consortium of service providers to achieve a long-term collaboration. In contrast, a more dynamic set-up of a loose-tied alliance for a time-limited task-oriented cooperation is conceivable. The decisive difference between a conventional electronic (shopping) mall and these two forms of organizing an EEM is that it is the intermediaries that initiate and run the EEM in the electronic marketplace and not the suppliers.

2.2 Mall Services

Primarily, mall services have to support all phases of an EEM-centered transaction in an appropriate way. This includes customer-initiated transactions (e.g., retrieval, customization, booking, use and payment of MBLRs) as well as supplier-initiated transactions (e.g., production and delivery of new MBLRs).

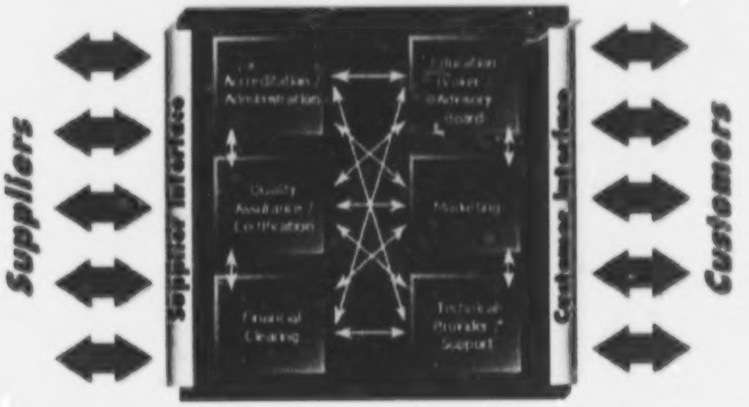
Suppliers
Supplier Interface
Accreditation / Administration
Quality Assurance / Certification
Financial Clearing
Education Broker / Advisory Board
Marketing
Technical Provider / Support
Customer Interface
Customers

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Figure 1: Approach of an Electronic Education Mall

Mall services are accessible via customer and supplier interfaces (see [Fig. 1]). In addition, communication and coordination mechanisms among the mall service providers are realized by "horizontal" information and data interchange within an EEM. From a conceptual point of view, each mall service can be subdivided in a multitude of functionalities. [Tab. 1] shows some examples.

Accreditation and Administration	***Education Broker and Advisory Board***
• accreditation and registration of new customers • booking of MBLRs • accreditation and registration of new suppliers • generation of supplier profiles	• pedagogical and didactical advice for customers and suppliers • customizing of MBLRs according to customers' specific needs • mediation of human resources, e.g., coaches, instructors, tutors, speakers, etc.
Quality Assurance and Certification	***Marketing***
• information on quality and certification guidelines of the EEM • certification of new MBLRs • quality assurance measures	• information on the supply of an EEM (suppliers, contents, certificates, financial conditions, special offers, etc.) • marketing for single MBLRs as well as for the whole EEM • provision of customer profiles and market surveys
Financial Clearing	***Technical Provider/Support***
• support of pricing new MBLRs • development of individual and flexible payment procedures for MBLRs • negotiation about special conditions within price ranges defined by the supplier • accounting of MBLRs and mall services inquired by the customer or the supplier respectively	• consultation/information related to technical requirements to produce and use MBLRs (bandwidth demand, operating systems platforms, tools, etc.) • technical support during the delivery phase of new MBLRs (setup of server capacities and network connections, etc.) • technical support during the learning process (installation of required tools, setup of online connections, etc.) • technical support of MBLRs (maintenance, re-implementation, software updates, etc.)

Table 1: Mall Services and Their Respective Functionalities

2.3 Market Transaction Support

According to the classical market transaction scheme (cf. e.g. [Williamson 1985, 20]) a customer-initiated transaction within an EEM can basically be subdivided in the phases of information, negotiation and settlement. At a more detailed level the transaction consists of 10 sub-phases, steps (1) to (3) being assigned to the information phase, steps (4) and (5) to the negotiation phase and steps (6) to (10) to the settlement phase. A description of a customer-initiated transaction performed in an EEM is given below. [Fig. 2] illustrates which service providers are involved in each sub-phase to support the respective steps. Some tasks can be fulfilled by just one mall service provider whereas other tasks require coordinated cooperation and/or information interchange of two or more service providers.

Steps of a Customer-Initiated Transaction (example)

(1) Gathering information about the supply, e.g., on service and price structures, quality of supply, current references and rankings, certification criteria.

(2) Obtaining educational advice, e.g., information on learning contents from a pedagogical point of view, proposal of an appropriate MBLR or a bundle of resources.

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(3) Configuring and customizing individual MBLRs according to customers' specific needs.
(4) Negotiating prices and special conditions like credits, discounts, etc.
(5) Booking of the chosen resources according to the negotiated conditions; accreditation of the customer.
(6) Preparing the technical environment, e.g., reservation of bandwidths, installation of tools, request for keys to access restricted MBLRs.
(7) Using the booked MBLRs.
(8) Taking online exams to receive a certificate.
(9) Accounting and payment.
(10) Delivering the certificate.

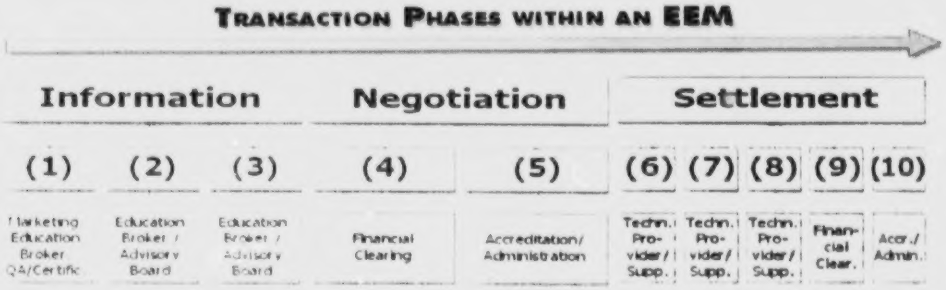

Figure 2: Transaction Phases and Mall Services

3 Implementation

3.1 Mall Service Support Systems and User Interface

Core components of the EEM are so-called *Mall Service Support Systems* (MSSS), which support the individual service provider's tasks electronically. MSSSs can be standard software and hardware (e.g., videoconferencing systems), adapted or customized systems (e.g., payment systems) or specific solutions developed for a certain need (e.g., agent systems, configuration systems). On the basis of the customer-initiated transaction (cf. chapter 2.3) some examples of MSSSs which facilitate the complete electronic transaction support are given below.

The marketing unit offers the customer different self-service approaches for obtaining general information on the EEM and the MBLRs – e.g., electronic product (MBLR) catalogues as key elements of electronic markets [Schmid 1997, 4], bulletin boards, search engines or agent-based search mechanisms, newsletters, and push channels. Besides, the customer can specify his need for information using synchronous (e.g., videoconferencing or chat) or asynchronous (e.g., email) communication channels. The same communication mechanisms can be used for obtaining individual educational advice provided by the advisory board. The advisory board can be supported by case databases and soft computing (e.g., expert systems). (Semi-) automized advice by using consultation agents is conceivable.

The education broker uses specific configuration systems supporting the MBLR customization and facilitating also the bundling of different MBLRs. For standard requests direct MBLR retrieval by the customer is possible.

In the negotiation phase, the financial clearing can use (agent-based) price finding and negotiation mechanisms (e.g., to negotiate on special conditions and discounts within price ranges defined by the supplier). The bookings of MBLRs are supported by electronic contracting processes. The collection of customer data and the accreditation of new customers can be done using CGI- or Java-based forms.

The support given by the technical provider to customers in the phases of preparing and using the MBLRs can be remote administration and installation. If necessary, the customer and the technical provider can communicate with each other synchronously or asynchronously via the channels mentioned above. MBLRs and services are being paid for by means of electronic payment systems using appropriate security mechanisms such as SET (Secure Electronic Transactions).

Also, flexible accounting mechanisms systems are to be deployed to make the payment of heterogeneous

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bundles of MBLRs and services easier and more economical. Finally, the certificates are being handed over in the form of electronic documents, providing that their authenticity is guaranteed by suitable cryptographic mechanisms.

The "visible" part of an EEM is to be realized as a Web-based interface, which allows suppliers and customers to access all relevant services offered by mall service providers. In addition, a separate interface for mall service providers has to be implemented, through which they can administer and use their respective MSSSs.

3.2 MBLR Production and Delivery

In addition to the implementation approach of the EEM and its support systems for each service provider the question of an appropriate technical framework for the production and the delivery of MBLRs has to be dealt with. [Fig. 3] shows a layer-oriented reference model. The very top layer contains specific production and application systems for suppliers and customers. The layers underneath are transport layers. The normalization of the framework is achieved by adhering to relevant standards and protocols.

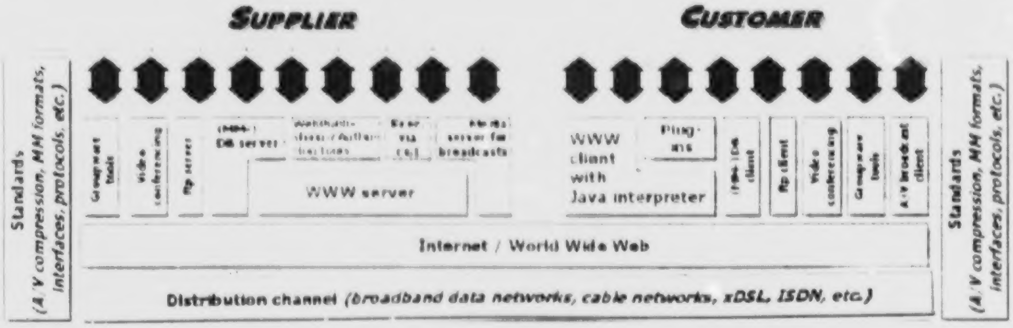
SUPPLIER
CUSTOMER
Standards (A/V compression, MM formats, interfaces, protocols, etc.)
Groupware tools
Video conferencing
ftp server
DB server
WWW server
WWW client with Java interpreter
Plug-ins
Video conferencing
Groupware tools
A/V broadcast client
Internet / World Wide Web
Distribution channel (broadband data networks, cable networks, xDSL, ISDN, etc.)
Standards (A/V compression, MM formats, interfaces, protocols, etc.)

Figure 3: Technical Framework for MBLR Production and Delivery

The WWW serves as a production and presentation platform for the supplier. Web publishing tools like HTML editors or graphic applications are used. In addition, authoring and programming tools are needed. Looking at specific MBLRs, the framework offers a variety of design and realization possibilities. For instance, Web-based teachware packages can integrate Web-compatible media formats (text, graphics, audio, video, etc.) as well as components which are connected via the common gateway interface CGI (e.g., databases, executables for the evaluation of progression tests).

Furthermore, CGI-independent executables like Java applets and servlets, JavaScript and ActiveX modules are also connectable. A lecture-on-demand service can be provided by using a (Web-based) audio/video broadcast server. Multimedia databases are needed to build up electronic references as well as Web-based information and knowledge pools. Electronic instruction and lecture materials and non-Web-based teachware applications are offered for download either from the Web server or from a dedicated download server (ftp server).

Synchronous teaching and learning approaches are usally based on videoconferencing and groupware systems (e.g., the MBone toolset) which nowadays do not work predominantly Web-based. However, the further development of the WWW to support synchronous multimedia communication can be foreseen.

The customer's access to the Web-based modules is realized by a conventional Web browser which can be extended by plug-ins if necessary. Dedicated clients and frontends facilitate the use of non-Web-based applications.

4 Current Status

Encouraged by the emerging commercial structures in the fields of education and training, especially media-based teaching and learning concepts with promising market potential are being prototypically realized and evaluated at the University of Erlangen-Nuremberg. Since 1994 multilateral synchronous teleteaching scenarios

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based on broadband data networks, videoconferencing, and groupware systems are being run [Bodendorf, Grebner & Langenbach 1997], covering national and international universities as well as partners from industry and administrative authorities. Examples are distributed lectures, talks, seminars and workshops between university and practice.

Furthermore, in analogy to the well-known video-on-demand a lecture-on-demand service is provided. Talks and lectures are stored in digitized form on a media server for an on-demand retrieval with supplementary learning materials offered via WWW. The media-based teaching and learning program at the University of Erlangen-Nuremberg is completed by a set of Web-based multimedia teachware packages [Langenbach & Bodendorf 1997].

In parallel to the development of media-based learning resources and teaching concepts with relevant market potential the prototypical realization of an university-oriented EEM (called *NOVEM* – *N*uremberg *O*pen *V*irtual *E*ducation *M*all) is in progress. In addition, a number of MSSS for transaction support have been designed and realized as prototypes. Examples are an electronic MBLR catalogue, a price finding mechanism based on regression analysis, or an education broker toolset for Web-course customization. The prototype of this toolset – presented at WebNet 98 [Langenbach & Bodendorf 1998b] – was nominated for the international software award "Multimedia Transfer 99" of the German Academic Software Cooperation. The whole range of services of NOVEM is accessible for suppliers, customers and mall service providers via a standardized Web-based interface (designed in plain HTML as well as in VRML).

5 References

[Bodendorf, Grebner & Langenbach 1997] Bodendorf F., Grebner R. & Langenbach C. (1997). Telelearning in the Virtual Lecture Theatre. *Displays* 3-4 (17), 147-151.

[Byrne 1993] Byrne J.A. (1993). The virtual corporation. *Business Week* (1993/02/08), 98-103.

[Hämäläinen, Whinston & Vishik 1996] Hämäläinen M., Whinston A.B. & Vishik S. (1996). Electronic Markets for Learning: Education Brokerages on the Internet. *Communications of the ACM* 6 (39), 51-58.

[Kalakota & Whinston 1996] Kalakota R. & Whinston A.B. (1996). *Frontiers of Electronic Commerce*. Reading: Addison-Wesley.

[Langenbach & Bodendorf 1997] Langenbach C. & Bodendorf F. (1997). A Framework for WWW-Based Learning with Flexible Navigational Guidance. In: Lobodzinski S. & Tomek I. (Eds.). *World Conference of the WWW, Internet, & Intranet*. Charlottesville, 337 - 343.

[Langenbach & Bodendorf 1998a] Langenbach C. & Bodendorf F. (1998). An Electronic Mall Approach for Media-Based Learning. In: Lee J.K., Kim S.H., Whinston A.B. & Schmid B. (Eds.). *International Conference on Electronic Commerce*. Seoul, 289-294.

[Langenbach & Bodendorf 1998b] Langenbach C. & Bodendorf F. (1998). An Education Broker Toolset for Web-Course-Customization. In: Maurer H. & Olson R.G. (Eds). *World Conference of the WWW, Internet, & Intranet*. Charlottesville, 533-538.

[Mowshowitz 1997] Mowshowitz A. (1997). Virtual Organisations. *Communications of the ACM* 9 (40), 30-37.

[Schmid 1993] Schmid B. (1993). Elektronische Märkte. *Wirtschaftsinformatik* 5 (35), 465-480.

[Schmid 1997] Schmid B. (1997). Requirements for EM-architecture. *Electronic Markets* 1 (7), 3-6.

[Stich 1999] Stich M. (1999). Ansätze der IV-basierten Transaktionsunterstützung in der Aus- und Weiterbildungsbranche. Survey. Department of Information Systems, University of Erlangen-Nuremberg.

[Turoff 1999] Turoff M. (1999). Education, Commerce, and Communications: The Era of Competition. *WebNet Journal 1 (1)*, http://eies.njit.edu/~turoff/Papers/webnettalk/webnettalk.htm, 1999/07/07.

[Williamson 1985] Williamson O.E. (1985). *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. New York.

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Computer-Mediated Communication in AulaNet – a Web-Based Instruction Environment

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Abstract: This work presents the many forms of communication used in AulaNet <http://www.les.inf.puc-rio.br/aulanet/>—an environment for creating, administrating, updating and attending courses through the World Wide Web. This environment ensures the necessary conditions for communication, coordination and cooperation among the participants of a course. These communication mechanisms include administrative procedures, discussion lists, news, agenda, announcements, e-mail messages, chat and videoconference. Almost all the information exchanged is stored in databases allowing for information retrieval.

1. Introduction

Communication in cooperation environments is of fundamental importance in establishing the necessary conditions for effective coordination and cooperation among the participants in these environments [Ellis, Gibbs & Rein 91]. Communication in a determined cooperation environment is one of the main characteristics that defines the profile of such an environment. [Brooks 75] states that Organization is communication.

The popularization of the use of computers in conjunction with the Internet has been transforming the way that people carry out the most varied activities [Tapscott 98]. Computers are being used with increasing frequency to obtain services, for work, education/training, entertainment and many other activities.

Gradually, computers are becoming more like communication devices, with the desired activities installed in the processing capacity, similar to the process installed in a digital telephone or in a bank cash dispenser. When a computer is connected to the Internet, whether through a modem using a telephone line or connected to a LAN, it is not the same machine as the very same computer disconnected. In this context, the computer allows a person to interact with a wide range of objects spread around the world. Computers continue to be machines with many uses, but they are beginning to be increasingly perceived and used as a medium for various types of communication [Perrone et al. 96].

[Poster 94] makes an analysis of the impact that the forms of communication have on society. For example, he analyzes how the concepts presented in tv commercials influence people's behavior in contemporary society. [Melody 94] makes a correlation between information and communication and affirms that the way a society functions depends on information and the efficiency of the communication of this information among its members. [Barlow 94] defines a taxonomy of information and maintains that among other characteristics information is a relationship.

The way in which information is becoming increasingly accessible and the increase in the speed at which information is being updated is creating the necessity for people to be continually learning. Society is heading in the direction of workers having to be constantly updated, thus creating a situation in which working and learning environments are converging.

This new culture of access to information and people has been generating a variety of environments and, more specifically, cooperation environments in which various people can perform activities in groups. These activities are often associated to education/training or work which tends to transform into the same type of activitiy.

One of these types of environment is designed for distance education. The concept of distance education is not new; it is associated to educating people where distance makes communication difficult between those who are consuming knowledge and those who are transmitting it. In general this type of distance education offers less possibility for teachers and students to communicate than traditional teaching methods where all participants are present [Romiszowsky 97].

AulaNet is an environment for creating, administrating, updating and attending courses through the Internet. It has been developed in the Software Engineering Laboratory (LES) of the Computer Science Department at the Catholic University of Rio de Janeiro [Lucena et al. 99]. AulaNet offers, among other facilities, various types of communication integrated in one unique environment that allows communication, coordination and cooperation among the partipants on a course.

One of the differences between teaching environments on the Internet and traditional forms of teaching with the participants present is the fact that distance courses are offering many new possibilities for communication between the participants in a group. These new environments on the Internet allow participants to interact at a greater level of intensity [Fussel et al. 1998].

2. Computer-Mediated Communication

The development of the Internet and the World Wide Web has introduced new forms of communication into every day life. Nowadays it is possible to communicate with other people, go shopping, make bank transactions and perform many other activities from one's home with a computer connected to the Internet. All these activities have established protocols of communication that may have distinct objectives referring to anything from entertainment to work commitments.

There are a variety of applications on the Internet that allow people to communicate with one or more persons, or to communicate with automatic procedures through the Web like for example buying a CD, transferring a software or enrolling in a course given through the Internet.

The first application to become popular was email which is being used more and more frequently all the time. Some enthusiasts are even calling it the third revolution, the first two being the written word and the printing machine [Nunberg 96]. It is increasingly common for people and companies to have an email address. Email is very accessible and one of its advantages is that it has a very low cost. It uses a small bandwith of the Internet and nowadays there are even many free email services. In the beginning email was used by the scientific community but it is now becoming more widespread in everyday life. One example is the use of email to swop messages between people as a substitute for the traditional mail services. Email is also being used increasingly at work as a form of communication that substitutes the traditional memo and to request technical assistance as a substitute for telephone calls, etc...

Two other popular communication applications on the Internet are IRC (Internet Relay Chat) and ICQ (I Seek You). IRC is an application that allows various people to communicate through text in real time. ICQ appeared in November 1996 and two years later it already had 2 million registered users. It is a freeware application that allows a person connected to the Internet to know that other people are connected at that same moment using ICQ, thus enabling communication between these people through a type of email with a very short message reply time, giving the impression of conversation in real time. Both IRC and the ICQ have the facility to transfer files.

Videoconference is another form of communication that is increasily used on the Internet. Examples of videoconference tools used on the Internet are CU-SeeMe, initially developed by Cornell University and currently being commercialized by White Pine Software, and Netmeeting developed by Microsoft. In a videoconference it is possible for various participants to communicate through audio, video and text. The participants of a videoconference can also interact through a whiteboard where various types of material are shared. For example, it is possible for somebody taking part in a videoconference to put a figure on the whiteboard and for someone else to indicate points that should be corrected in the figure. [Laufer & Fuks 98] present an experiment in which videoconference was used in an environment for cooperative learning.

The conjugation of the Web with databases, CGI and Java has been making an ever increasing range of services available on the Internet. It is currently possible to make the most diverse purchases through the Internet, from buying a book or CD to doing your weekly shopping at the supermarket. Nowadays, many banking services are also offered through sites on the Internet that enable account holders to undertake transactions with their accounts from their office or home.

These diverse forms of communication using the Internet are classified according to different criteria. [Long & Baecker 97] propose a taxonomy for the communication tools used on the Internet in which various characteristics are taken into consideration, like conversational synchronisation and style, audience membership and communications media, among others. These tools are analyzed individually but the type of use most suitable for each tool is not taken into consideration.

Each of these tools individually has a suitable use for a certain type of activitiy, with advantages and disadvantages depending on the activity. For more complex activities it would be convenient for a group of available tools to exist and that each of these tools be used in situations most suitable to its functionalities, thus increasing the potentiality of integrated use of these tools.

3. Computer-Mediated Communication in AulaNet

AulaNet is an environment for creating, administrating, updating and attending courses through the Internet. There are three actors involved in AulaNet: the administrator, the teacher and the student. In order to enter the AulaNet environment it is necessary to register. Once the administrator has accepted a person's registration he may make a request to enroll in one of the courses offered. If a participant would also like to be a teacher in AulaNet, which would allow him to create courses, it is necessary to make a teaching request that is analyzed and accepted or rejected by the administrator.

There are six steps to be followed in order to create a course in AulaNet. First the teacher must define the general course information, for example, the course name and syllabus. Then in the next three steps the teacher defines the communication, cooperation and coordination mechanisms to be used. Figure 1 shows the screen in which the teacher chooses the communication mechanisms of a course.

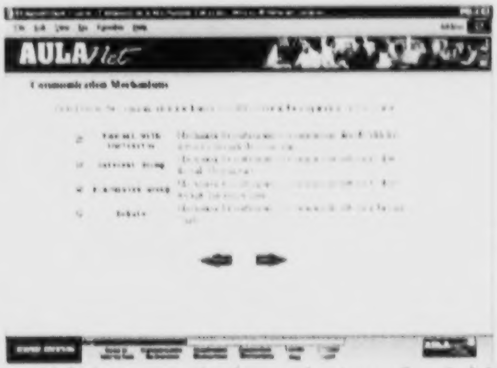

Figure 1: Interface in which the communication mechanisms of an AulaNet course are chosen

In the fifth step to creating a course in AulaNet the teacher defines a lesson plan and finally, in the sixth step, the teacher inputs the course material. The course material is transferred directly from the teacher's machine to the AulaNet server. At the moment AulaNet accepts material on the following formats: html, pdf, powerpoint, shockwave, toolbook, real, gif, jpg, avi and mov.

A course created in AulaNet supplies the teachers and students with various types of communication integrated in one unique environment that allows for communication, coordination and cooperation among the diverse participants of the course. We will now present some of the communication and coordination mechanisms that may be chosen by the teacher for a specific course.

The discussion list allows students enrolled in the course to send a message to all the others members on the course. This message is sent to all the other participants through email and is stored in the AulaNet database. Therefore, when a student enters the AulaNet environment and more specifically the environment of a certain course he can read all the messages that have already been sent to the discussion list through the Web interface.

The course news topics are defined by the instructor and contain subjects of interest to the community. Any community member can post messages in the news feature, however such messages, differing from the discussion list, are only accessible using the Web interface.

The teacher decides where the course discussions should take place, either in a discussion list or a newsgroup. In the postgraduate course Information Technologies Applied to Education given in the Computer Science department of the Catholic University of Rio de Janeiro, general discussions take place on the discussion list. When a theme on the discussion list becomes more important a specific newsgroup is created and the discussion about that theme is transferred to the newsgroup.

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There are various possibilities for sending email messages in AulaNet. A student can send an email to the instructor of a course in which he is enrolled. The administrator can send messages to a specific student or teacher or to all the teachers and all the people registered in the environment. The sending of email messages is carried out in the actual AulaNet environment through filling in a form.

Webchat and CU-SeeMe videoconferencing technology are the synchronous forms of communication offered by AulaNet. Consulting the course agenda, students are informed that a chat session or a CU-SeeMe videoconference will take place. Real technology is used for broadcasting lectures.

The agenda has information about commitments established for the community. Announcements are posted by the instructor to inform the community about, for example, the postponement of a course activitiy.

4. Administrative Procedures

Within a cooperation environment there exists a variety of procedures that need a communication in order to be established. There are various administrative procedures within the AulaNet environment, like for example: participant registration, authorization to teach, the creation of courses, course enrollment, etc... Many of these procedures call for communication between the actors in the environment.

In version 1.0 of AulaNet participant registration was carried out automatically and did not require any authorization on behalf of the administrator. Once a request to register in the environment was made, the participant was automatically given authorization to request enrollment in any of the courses offered. Figure 2 shows a diagram representing a request to register in version 1.0 of AulaNet.

Request to register
Accept request to register

Figure 2: Diagram of Request to Register in Version 1.0 of AulaNet

In version 1.2 of AulaNet participant registration implies in a communication between the administrator and the person wanting to register. When a person makes a request to register in the environment an email is sent to the administrator informing him of the request. From that moment a negotiation process begins between the administrator and the person making the request. Depending on the information exchanged in this communication the administrator may accept of refuse the applicant, which means that this person may or may not have access to AulaNet. Figure 3 shows a diagram representing a request to register in version 1.2 of AulaNet.

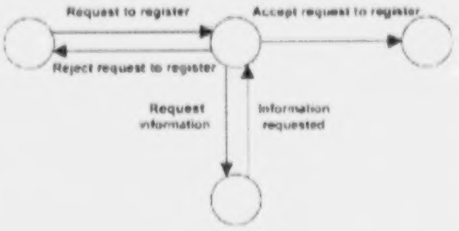

Figure 3: Diagram of Request to Register in Version 1.2 of AulaNet

All the messages are sent within the AulaNet environment and are stored in the AulaNet database. In this way it is possible to follow the whole process until the administrator decides to accept or reject the registration request using the actual AulaNet environment. Figures 4 and 5 present the administrator's interface and the applicant's interface respectively.

All the communication related to the administrative procedures in AulaNet is carried out from the Web interface. The information related to this communication is stored in the AulaNet database thus allowing for the communication established during a determined procedure to be retrieved.

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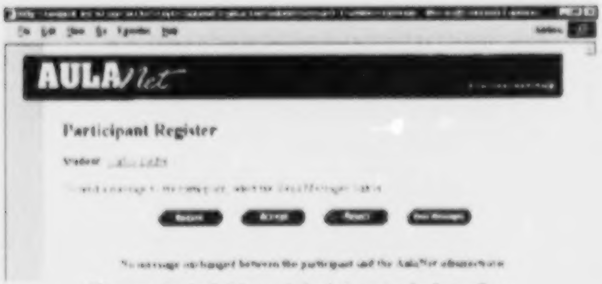
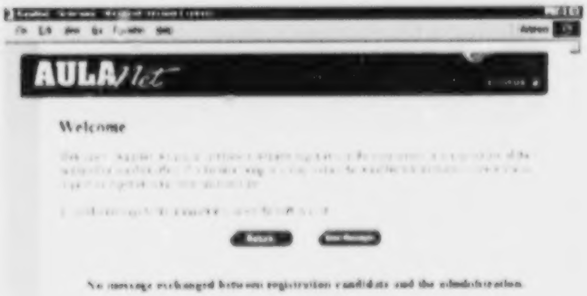


Participant Register

No message exchanged between the participant and the AulaNet administrator

Figure 4: AulaNet - Administrator's Interface



Welcome

No message exchanged between registration candidate and the administration.

Figure 5: AulaNet - Applicant's Interface

5. Conclusion and Future Work

The growing popularity of the Internet and the Web has been generating a variety of cooperation environments where various people can carry out activities in groups. These activities are often associated to education/training or work which tends to transform into the same type of activity.

The way in which information is becoming increasingly accessible and the increase in the speed at which information is being updated is creating the necessity for people to be continually learning. Society is heading in the direction of workers having to be constantly updated, thus creating a situation in which work and learning environments are converging.

Communication in cooperation environments is of fundamental importance in establishing the necessary conditions for effective coordination and cooperation among the participants in these environments. Communication in a determined cooperation environment is one of the main characteristics that defines the profile of such an environment.

AulaNet is an environment for creating, administrating, updating and attending courses through the Internet, that supplies teachers and students with various forms of communication integrated in one unique environment that allows communication, coordination and cooperation among the participants on a course.

The role of the teacher is transforming because in computer-mediated cooperation environments the concept of confinement no longer exists, whereby at a set time and place a teacher presents knowledge to a class of students forbidden to communicate among themselves. Computer-mediated cooperation environments offer a group of possibilities for communication among the participants of a course thus allowing for a more intense exchange of information and personal experiences. Therefore, the teacher changes from being a transmitter of information to a motivator and mediator of a group in a more constructivist form of learning. It is up to the teacher to organize the type of communication among the participants in order to avoid a cognitive overload faced with the volume of information to be dealt with. An adequate choice of the type of communication to be used to perform a certain task may positively influence the coordination and cooperation among the participants of a project [Gay & Lentini 95].

For future work we will observe and study the communication processes arising from the interaction among actors of computer-mediated cooperation environments, with an aim to define communication patterns. Within a cooperation environment there exists a variety of procedures that need a communication in order for them to be established. This

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communication often presents a pattern of repetition. [Laufer & Fuks 95] define conversational clichês from conversations that repeat for certain situations. For example, it could be possible to define a group of communication patterns to be configured for each administrative procedure. A cooperation environment could be configured according to certain communication patterns suitable for a specific institution. At the moment, a participant with permission to teach does not need any authorization to create courses in AulaNet. At a certain moment, it could be desirable that course creation be preceded by an authorization on behalf of the administrator, which would result in a communication between the teacher and the administrator.

Taking the study of communication patterns as a starting point we also aim to define ways of registering the information generated during the negotiation carried out during communications, which often defines commitments between the participants of a communication. In this way we could retrieve a record of the processes associated to a determined communication pattern and the options and justifications for reaching decisions within computer-mediated cooperation environments.

Communication in computer-mediated cooperation environments is one of the main characteristics that defines the type of environment. It is necessary for computer-mediated cooperation environments to offer an integrated group of different forms of communication with the possibility of customizing their communication protocols, thus allowing for a more agile generation of environments with different profiles to appear.

6. References

[Barlow 94] Barlow, J. P. (1994). The Economy of Ideas, Wired Magazine, Vol. 2, No. 3, March, <http://www.wired.com/wired/archive/2.03/economy.ideas.html>

[Brooks 75] Brooks, F. P. (1975). The Mythical Man-Month: Essays on Software Engineering; Menlo Park, CA, Addison-Weslley Publishing Company

[Ellis, Gibbs & Rein 91] Ellis, C. A., Gibbs, S. J., Rein, G. L. (1991). Groupware: Some Issues and Experiences, Communications of ACM, Vol. 34, No. 1, pp. 39-58, January

[Fussel et al. 98] Fussel, S. R., Kraut, R. E., Lerch, F. J., Scherlis, W. L., McNally, M. M., Cadizz, J. J. (1998). Coordination, Overload and Team Performance: Effects of Team Communication Strategies, Proceedings of CSCW 98, Seattle, Washington, USA

[Gay & Lentini 95] Gay, G., Lentini, M. (1995). Use of Communication Resources in a Networked Collaborative Design Environment, Journal of Computer-Mediated Communication, Vol. 1, No. 1, <http://jcmc.mscc.huji.ac.il/vol1/issue1/IMG_JCMC/ResourceUse.html>

[Laufer & Fuks 98] Laufer, C. & Fuks, H. (1998). Rio Internet TV — AulaNet; Videoconference in Web-Based Learning; Proceedings of WebNet 98, Orlando, USA

[Laufer & Fuks 95] Laufer, C. C. & Fuks, H. (1995). ACCORD: Conversation Clichês for Cooperation; Proceedings of The International Workshop On The Design Of Cooperative Systems, Juan-les-Pins, France

[Lucena et al. 99] Lucena, C. J. P., Fuks, H., Milidiú, Laufer, C., Blois, M., Choren, R., Torres, V. & Daflon, L. (1999). AulaNet: Helping Teachers to Do Their Homework, Multimedia Computer Techniques in Engineering Education Workshop, Technische Universitat Graz, Graz, Austria.

[Long & Baecker 97] Long, B., Baecker, R. (1997). A Taxonomy of Internet Communication Tools, Proceedings of WebNet 97, Toronto, Canada

[Melody 94] Melody, W. (1994). Electronic Networks, Social Relations and the Changing Structure of Knowledge, Communication Theory Today, pp. 255-273, Stanford University Press.

[Nunberg 96] Nunberg, G. (1996). Farewell to The Information Age, The Future of The Book, pp. 103-138, University of California Press.

[Perrone et al. 96] Perrone, C., Pepenning, A., Spencer, S., Ambach, J. (1996). Computers in the Classroom: Moving from Tool to Medium, Journal of Computer-Mediated Communication, Vol. 2, No. 3, <http://jcmc.mscc.huji.ac.il/vol2/issue3/perrone.html>

[Poster 94] Poster, M. (1994). The Mode of Information and Postmodernity, Communication Theory Today, pp. 173-192, Stanford University Press.

[Romiszowsky 97] Romiszowsky, A.J. (1997). Web-Based Distance Learning and Teaching: Revolutionary Invention or Reaction to Necessity?, Web-based instruction, pp. 25-37, Educational Technology Publications, New Jersey.

[Tapscott 98] Tapscott, D. (1998). Growing Up Digital: The Rise of the Net Generation, McGraw-Hill, New York.

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Sharing and Re-use of Clinical Incident Information on the Web

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Abstract: Harmful events, which occur during the provision of health care, can be costly and deadly. The challenge for clinicians and health professionals is to eliminate or at least reduce occurrence of these events to improve quality of care. This paper introduces a web-based intelligent system for managing the clinical incidents. The development of the system is an integration of rule-based reasoning, case-based reasoning and causal-based reasoning over the net infrastructure. The use of heuristic knowledge, previous cases as well as causal models facilitates the implementation of analysing, browsing and explaining clinical incident knowledge. The resulting system leads health professionals to share knowledge/experience on active and latent human failures and the re-use of such information increases clinical safety awareness.

1. Introduction

More than 80% of needless injury and or death among hospital patients in Australia is caused by human error [Johnson 1999]. For example, with the patient receipt of an inappropriate drug, the error is often associated with incorrectly dispensing or incorrectly prescribing due to similarity of medication names. The challenge for clinicians and health professionals is to eliminate or at least reduce occurrence of these incidents in order to increase care quality and reduce harm to patients. Therefore, it is important that we learn as much as possible from these incidents to prevent mistakes in the future and improve patient care.

Increased interest in quality improvement in health care has led to greater recognition that errors occur. However, the study of clinical errors, accidents or incidents is still in its relative infancy [Vincent et al 1993, Leape 1994, Bhasale *et al* 1998]. It is important to look at all aspects thorough analysis of incidents or accidents. These aspects should include identification of what actually happened; description of how it happened; identification of the causes and contributing factors (why) and determination of preventability and possible safeguards [Bhasale 1998]. It should be noted that although in some cases a negative outcome can not be prevented, but the conditions and factors that created a potential harmful situation are still of interest.

The World-Wide Web (WWW) represents one of the most powerful instruments for the creation and dissemination of information. One of the effects of the Web is a widening of the population of those who publish information. Health care has always been information rich, but has severely been limited by mechanisms for distribution and access to that information [Coiera 1996, 1997]. However, there comes the possibility of sharing such information whenever the need applied [Riva et al 1998]. Therefore, we aim to assist health professionals to explore medical incidents globally in order to identify how and why these incidents occurred in more detail and suggest improvements to prevent and mitigate their effects.

This paper introduces a Clinical Incident Management (CIM) system, a web-based intelligent system, to allow clinicians and/or other health professionals to complete structured incident reports about any event which has caused harm and can cause potential harm. The repository of clinical incident reports provides analyses of individual incidents such as type of incident, contributing factors and possible causes. When a new incident is reported, a set of intervention strategies is recommended to reduce the chances of similar problems occurring. The system enables health professionals to achieve a better understanding of possible underlying causes of specific groups of incidents. The system also performs statistical analyses to indicate potential or actual harm to general practice patients. In addition to incident analysis knowledge, the CIM provides justification knowledge of suggested intervention methodology to the given clinical incident. The resulting system enables health professionals to share the medical incident information, which has caused harm and can cause potential harm. The re-use of such information may prevent or mitigate human or medical errors.

2. Major Functions of the CIM System

Major functionality of the CIM system includes incident analysis and advisory, explanation and justification, case-base browser, quantitative descriptive analysis and knowledge management as shown in figure 1. This section will concentrate on the description of these functions.

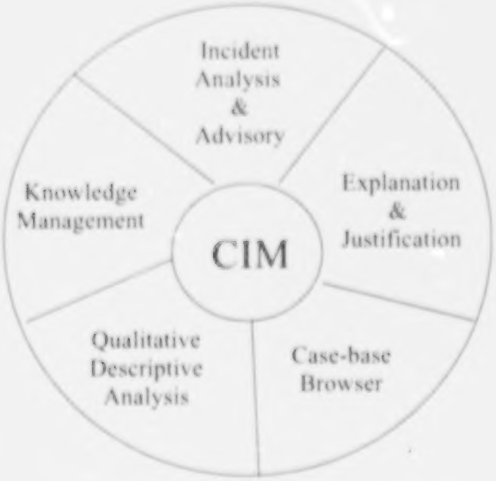

Figure 1. Major functions of the CIM system.

2.1 Incident Analysis and Advisory

The incident analysis and advisory function is based on health professionals providing incident reports in order to investigate the underlying problems in the given incident and suggest interventions for preventing these problems. In reporting the incident, an incident profile is provided by health professionals. The incident profile includes the patient's information (age and sex), incident outcomes (potential harm, immediate consequences and preventability) and general description of the incident.

The CIM system then assists the users to analyse the incident by identifying types of problems involved in, their features and possible causes. The type of incidents can be classified as pharmacological, diagnostic, or other incident types. The incident features consist of factors contributing to incident types. For example, diagnostic incidents can either relate to clinical judgement in assessing the patient or poor communication (between GP and patient, or between health professionals). The possible causes identify the causes relating to the incident features, such as errors in judgement may cause by failure to recognise significant symptoms and signs.

Case-based Reasoning (CBR) and Rule-based Reasoning (RBR) are applied to the incident cases analysis and generation of intervention knowledge. The CIM system searches through the incident case base. If a matched sub-case can be found based on the incident types, features and causes, the interventions in this sub-case are adapted as interventions to the problem. Otherwise, the generalised rules for interventions are applied to produce recommendations using heuristic knowledge.

2.2 Explanation and Justification

The explanation task is to answer how that causes are determined and the justification task provides extra information of the suggested intervention, which leads to potential benefits and advantages of using suggested interventions. Rule-based approach which can be used to represent and reason about the events that lead to major accidents. However, this is of little benefit if analysts cannot achieve a better understanding of the causes of the "errors" [Johnson 1997]. Causal Reasoning therefore is applied to identify causes of an incident that might otherwise be lost in the incident report [Wick 1993].

A frame-based knowledge base representation in the form of a causal graph is used to capture information for explanation and justification. The knowledge bases are represented as a collection of cause-effect relationships illustrated in Figure 2.

Activity: Contributing Factor (CF)
Index: CF-1
Text: "Poor communication between GP and patient"
Inference: lead to INT-3

Activity: Intervention (INT)
Index: INT-3
Text: "GP can use a clear statement for communication"
Inference: caused by CF-1, CF-3, CF-4

Activity: Explanation (EXP)
Index: EXP-1
Text: "Patient's Poor English"
Inference: determine for CF-1

Activity: Justification (JUS)
Index: JUS-10
Text: "Print prescriptions and provide with a clear medication names"
Inference: justify for INT-3

Figure 2. A frame-based representation of a causal model.

Using the representations illustrated in Figure 2, the inference transition is possible when relationships are found. For example, if an inappropriate drug incident occurred which was due to the poor communication between GP and patient. The intervention statement therefore leads to as "GP can use a clear statement for communication". The explanation of the cause may be the patient has poor English. The justification of suggested intervention is to print prescriptions and provide clear medication names.

2.3 Case-Based Browser

In order to maximise the usefulness of accident research, it is important to allow health professionals to browse previous incidents stored in the system. The development of the browsing functionality is based on case-based reasoning. It retrieves relevant incident cases/sub-cases according to users' queries. Should the user prefer to view certain cases specific to their interest, they can restrict their search in any of the five areas provided:

- Incident Profile
- Incident Type
- Incident Feature
- Possible Causes
- Interventions

Six options in the incident profile are provided for the user to specify their search parameters: patient's age, patient's sex, health problem, potential harm, immediate consequence, and preventability. When selected, these parameters are taken to be logically AND with each other. At any time, users can view the status of their query. The relevance of retrieved incident cases to the query is measured based on an attribute order that specifies the importance order of attributes used in the query [Zhang et al. 1999].

The advantage of using this case-based browser is that health professionals and end-users can glance over incidents in detail. Such a browsing functionality encourages the sharing and re-using information to identify clinical incidents and to illustrate preventable and especially system causes of such incidents.

2.4 Quantitative Descriptive Analysis

It is essential for the web users to gain an understanding of the type of incidents occurring in general practice and hence areas of potential harm; and to identify areas which might benefit from intervention. Quantitative descriptive analysis is used to provide the main features of the data for all incident cases.

Figure 3 shows four types of statistical analysis, which are provided in the CIM system:

- Age and Sex of Patients [histogram]
- Types of Incidents [pie chart]
- Features of Incidents [table]
- Outcomes of Incidents [table]

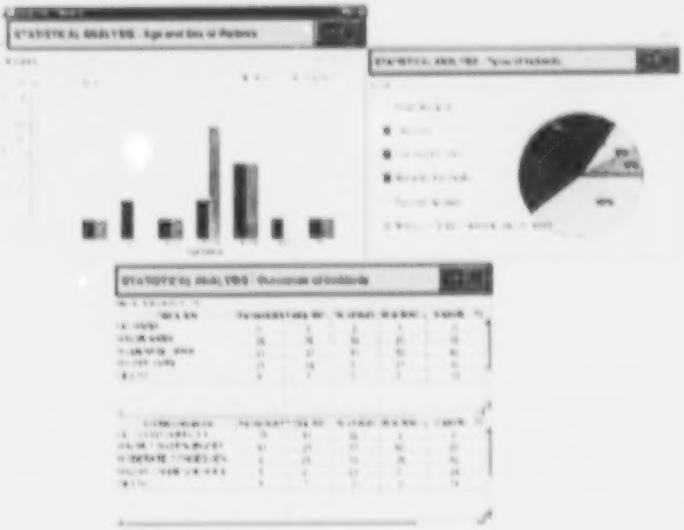

Figure 3. An example result of the statistical analysis

The age and sex of patients histogram displays the relative distribution of age and sex of patients in all the cases. The ages are categorised into 8 age groups. All toddlers and babies under 12 months is grouped into the "<1 year" age bracket. The incident pie chart displays the proportion of each incident type as a percentage of total number of cases. This analysis is dynamic and will update the percentages as new cases are entered or new incident types are reported. Ranking from the greatest to lowest, the twelve most frequently occurring incidents feature in the case base. While there may be other less significant incident features, they are not listed here and so as a result, the total percentage will not necessarily total 100%. The outcome of incidents table shows a breakdown of each incident type reported in the case base in the areas of potential harm and immediate consequences. The percentage proportion is shown for each of the 5 degrees of severity.

2.5 Knowledge Management

The knowledge management function is built for the maintenance of the incident case base and domain knowledge. It is designed for the knowledge engineers to access newly reported incident cases and insert appropriate interventions to the given incident. This is done by integrating the input incident

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profile with the analysis information and suggested interventions together. When new information or knowledge arrives, knowledge engineers can manually insert the new piece of information or knowledge into knowledge bases for future use. This new information or knowledge can be either based on user's input or new research results. For example, if there is no existing type of medical problems in the incident profile, uses can add a new type of medical problem in the "other" column of the list. Knowledge engineers then evaluate the problem type and integrate it into the knowledge bases.

It is important to consider the consistency of the formalisation when managing the domain knowledge. The CIM system provides built-in consistency checking and incoherence checking. The consistency checking is to ensure that new components do not conflict with current knowledge. The incoherence checking is concered with the representation schemes. For example, the relationships of problem types and contributing factors need to be maintained if a new problem feature is introduced. Therefore, when new problem features are inserted, associated problem types and contributing factors are provided for knowledge engineers to consider further relationships.

3. Implementation on the Web

The CIM system is developed to create web-accessible, distributed medical applications consisting of three main components: a set of inference engines, a long-term knowledge-base and case-base repository, and a graphical user interface. The knowledge bases and case bases consist of incident cases and generalised knowledge for intervention, explanation and justification as well as long-tem data storage. The reasoning engines manipulate the objects contained in the knowledge bases and case bases. The graphical user interface provides data collection and representation facilities.

The client-server implementation environment is based on an object-oriented approach using *Java 2* platform. The graphical user interface is implemented using the *Swing* API whereas the database is applied to SQL data base server.

Two types of security are involved in the system because security is also of fundamental importance in health care. The first involves setting up barriers to accessing knowledge-base and case-case files. Only the knowledge engineers can access these files as they are responsible for the maintenance of the repository. The second is the reporting GPs or health professionals who will receive an identification number with password to authenticate that they are privileged to use the system. In the reporting process, the patient's and health professional's names are anonymous as they are confidential information. The general public, however, is allowed to browse the system, but their input will not be saved to the repository.

4. Conclusions

The Web is increasingly being used as a platform to develop distributed applications, particularly in contexts, such as medical ones, where high accessibility and availability are required. In this paper we have introduced the development of a knowledge-based medical application on the Web to identify how clinical incidents occur and to illustrate preventable and especially system causes of such incidents. Our work is based on a Pilot Study of Incident Monitoring in Australia general practice [Bhasale et al 1998].

From the health care perspective, an important difference between our work and other studies such as Harvard Medical Practice Study [Leape et al 1991] is that we provide detailed contextual information about specific processes and situations. Such information is then used to make specific recommendations. From the knowledge-based systems perspective, rule-based reasoning, case-based reasoning and causal reasoning are all required for solving complex real world problems. However, there has been little prior work in integrating the three [Li 1999]. In this paper, a hybrid rule base, case base and causal base approach is proposed for improving the effectiveness of the rule-based reasoning system through the case-based and causal-based reasoning. Further more, we have presented a development environment for knowledge-based medical applications on the Web, which enhances the global accessibility and useability.

There are a couple of directions in which this research can be extended. Firstly, the linking of interventions to relevant on-line medical sources can be studied. In the current system, the suggested interventions only provide strategies. It will be useful to provide some references and guidelines associated with the suggested recommendations for a better understanding of the interventions. Secondly, the retrieval of relevant cases can be based on a flexible attribute order. A fixed attribute order is currently used to specify the important order for attribute. It is desirable to allow users to specify the order for attributes used in the query.

5. References

Bhasale, A., Miller, G., Reid, S. and Britt, H. (1998) Analysing Potential Harm in Australian General Practice: an Incident-monitoring Study, *Medical Journal in Australia*, Vol 169, 73-76, 1998.

Bhasale, A. (1998) The Wrong Diagnosis: Identifying Causes of Potential Adverse Events in General Practice using Incident Monitoring, *Journal of Family Practice*, 308-318, 1998.

Coiera, E. (1996) Artificial Intelligence in Medicine: the Challenges Ahead", *J. American Medical Informatics Assoc.*, vol 3, No 6, 363-366, Nov/Dec 1996.

Coiera, E. (1997) *Guide to Medical Informatics, the Internet and Telemedicine*, Chapman & Hall Medical, 1997.

Johnson, C. (1997) The Epistemics of Accidents, *International Journal Human-Computer Studies*, 47, 659-688, 1997.

Johnson, C. (1999) The Human Element in Hospital Mistakes, News in Science, http://www.abc.net.au/science/news/stories/s23731.htm, May 1999.

Leape, L. (1994) Error in Medicine, JAMA, 272, 1851-1857, 1994.

Li, L. (1999) Knowledge-based Problem Solving: an approach to Health Assessment, *Expert Systems with Application*, 16, 33-42, 1999.

Riva, A., Bellazzi, R. Lanzola, G., and Stefanelli, M. (1998) A Development Environment for Knowledge-based Medical Applications on the World-Wide Web, *Artificial Intelligence in Medicine*, 14, 279-293, 1998.

Vincent, C., Ennis, M. and Audley, R. (1993) Medical Incidents. *Oxford University Press*, 1993.

Wick, M. (1993) Second Generation Expert System Explanation, *in Second Generation Expert Systems, David et al (eds)*, Springer-Verlag, 615-640, 1993.

Wong, W. Lee, M., Zhang, D. (1999) Managing Clinical Incidents in General Practice, *AAAI99 Conference on Exploring Synergies of Knowledge Management and Case-based Reasoning*, in press.

Zhang, D., Lee, M and Wong, W. (1999) Using CBR for Clinical Incident Management, *1999 IEEE International Conference on Systems, Man and Cybernetics*, in press.

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Video on the Web: Principles of Continuity Linking and Narrative Flow

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Abstract: The emergence of video on the Web finally forces hypermedia designers to solve the problems of integrating dynamic information types (audio and video) in multilinear hypermedia structures. In dynamic documents, such as film, narrative flow and coherence is ensured by the four principles of continuity editing. In hypermedia environments these principles are easily applicable to the dymamic domains, but fall short when static information types (text and still images) are included in a linked structure. The linking of dynamic and static nodes transcends textual considerations and must take into account the different activity modes of the user-subject caused by the use of multiple information types (modes). The shift and oscillation between object-action (system-dominated activity) and subject-action (user-dominated activity) enforce a fifth principle of continuity linking: activity continuity. To achieve unobtrusive activity continuity and flow in multilinear and hypermedia narratives, various means at multiple textual levels are applied, including the original four principles of continuity editing in film.

1. Video on the Web and Storytelling

Due to continued improvements of both compression algorithms and bandwith, hypermedia in general, and the use of video in particular, is evolving rapidly on the World Wide Web. However, to date the linking of video and audio on the one side and text and graphics on the other, is discontinous and prevents the necessary narrative flow and contiguity needed for the Web to develop as an arena for multilinear hypermedia storytelling. Narrative flow within multilinear document structures is decisive in any kind of discourse involving argument, proofs, persuasion and reasoning, all of which are core ingredients of educational discourse. In hypertext and hypermedia research and development the use of video is suspiciously absent, apart from scattered attempts. [1] Hypertext research has traditionally been lingocentric and defined itself as non-multimedia. Another explanation might be that when video finally seemed to take off on the cd-rom platform in the early 1990s, the Web then apeared and gained popularity, with the result that the focus of hypermedia development was directed towards global hypertexts dominated by text and graphics rather than bandwith-demanding audio and video.

In 1970, hypertext-inventor and pioneer Ted Nelson described the possible development of an all-purpose hypertext in analogy with the history of motion pictures. [2] It took 20 years, from 1895 to 1915, before filmmakers, such as Griffith, discovered the inherent and formerly unknown features of film as a medium for storytelling. Today, 10 years after the general availability of integrated digital video and 30 years after Nelson's paper, dynamic information types are hot on the agenda in Web development and design. It is time to attempt to outline some of the relevant features inherent in this still new medium. In order to ensure support for multilinear storytelling we must ask: what are the principles of linking with dynamic nodes of audio and video in hypermedia Web-environments? To answer this question it might be relevant to first look at how segments of information have been combined (linked) in film and television which are the dominant media form of dynamic information types.

2. Narrative Contiunity in Film

When the novelty of watching movements on the screen faded in the early days of motion pictures, the dominant mode of film production, based on its theatrical influence, proved itself to be insufficient and dull. Film making had been organized around the *scene* as its fundamental building block. When Griffith made 'Birth of a Nation' in 1915, he switched to using the *shot* as the basic element. The shift from scene to shot marks the turn from the theatre as production model to the establishment of editing as the production technique inherent in and peculiar to film. However, when leaving the temporal and spatial continuum of the stable camera and the one-reel shot, the problem of *discontinuity* emerged. The joining together of individual shots, recorded in different positions and locations, had to be carried out according to certain principles in order to support the story which was being told. It was important – despite the fragmentation into different shots, of various length, content and visual appearance – to create a seamless experience of narrative coherence, making the fabrication of the film invisible. The way the film was actally composed and told, therefore, should not interfere with the experience of the storyline as it progressed. To achieve narrative coherence and flow, the *continuity* system of film production was discovered, invented and practised. For more than 80 years of cinematic production this has been the dominant style of film making and editing.

3. Continuity Editing and Continuity Linking

'Editing might appear to present a dilemma to the filmmaker. On one hand, the physical break between one shot and another may seem to have a disturbing effect, interrupting the viewer's flow of attention. On the other hand, editing is undeniable a primary means for constructing a film. How can one use editing and yet control its disruptive force?' [3] The strategy to balance this dilemma and to achieve narrative contiguity is known as *continuity editing* and employs four main principles of continuity: spatial, temporal, graphical and rhythmic. Spatial continuity is attained by strict adherence to the 180-degree rule which ensures a common space from shot to shot and a constant screen direction. Temporal continuity is achieved by focusing in the chronology of shots concerning action, event and cause, while at the same time supporting and sustaining the temporal manipulation of order, frequency and duration. Graphical continuity is obtained by matching the compositional display of objects, light, shade and actions between shots. Finally, rhythmic continuity relates the shot's duration to its camera perspective, information complexity, handling of distance, and display of action. These principles of continuity editing are operational principles or conventions, which may co-exist in a given conjoining of two shots. How, then, do they relate to hypermedia?

Hypermedia linking also presents a dilemma for the author/designer. The physical break between nodes may have a disturbing effect, interrupting the user's flow of attention and interaction. Alternatively, linking is undeniably a primary means of constructing hypermedia presentations. Obviously film and hypermedia have many features in common. [4] In general, we observe that, when linking within and between audio-video dominated nodes, the principles are applicable. This is due to the fact that, in hypermedia, shots and sequences form nodes, and linking becomes equivalent to editing, but handed over from the producer to the user. The problem, however, emerges when audio-video dominated nodes are linked to nodes dominated by text and still images. The 'flow' of a story being told to us in audio-video mode — linear or multilinear — is a quality inherent in these information types, which again is strictly conditioned by their temporal dependence. Text and still images, on the other hand, do not unfold over time.

4. Static and Dynamic

Audio and video are dynamic information types; they are conditioned by temporal sequence, and use time to unfold and come into being. Text and still image are static information types; they do not change over time. Linking within the dynamic domain adheres to the principles of film editing, though conventions for presenting link anchors and handling of temporal dimension are problematic and satisfactory solutions are still to be found. Linking of nodes within the static domain is relatively unproblematic, as we know from the Web and previous hypertext systems. [5] This is due to the fact that integration of static information types have long evolved in the literary and print tradition, and integration of dynamic information types has been fully developed in the film/television tradition. A problem arises when we cross this distinction maintained by the respective analogue traditions in combining the two within the same digital environment. The linking of dynamic and static nodes transcends the textual level of the digital material and must take into consideration the opposing kinds of *user activity* which are inherent in the two different domains of information types. Video/audio and text/image, respectively, have different ways of directing the user's behaviour when interacting with given information. The dynamic domain leaves us *passive* when it comes to generating the information and also in deciding its tempo of delivery, while the static domain presuppose the user's *active* participation for its tempo of delivery and existence.

5. Subject-action and Object-action

With the consumption of dynamic information the dominant activity is located in the textual object itself, as *object-action*; with the consumption of static information, however, the dominant activity is located with the user-subject, as *subject-action*. When we follow a link from a node dominated by dynamic information (for example video) to a node dominated by static information (for example text), this includes not only a shift from one type of information to another, but also a transition from one kind of subject-behaviour to another, from 'passive' to 'active', from object-action to subject-action. The user-subject must behave according to which information type is dominating the discourse. Such obtrusive shifts create a kind of discontinuity that might interfere with the flow and progress of multimedia and multilinear narratives.

The relationship between subject-action and object-action is further complicated by the fact that all link-following — every activation of a link — also is necessarily subject-action. Thus we have two kinds of subject-actions. One is enforced by the consumption of static information types themselves (subjective) and, at a more direct level, another occurs when the user-subject interferes with, intervenes in or manipulates the materiality of the message (objective). Subject-action, at this level, is again performed in several ways, from simple selection and activation, to more substantial and articulate input, which again influences object-action in various forms.

As a consequence, to obtain flow and continuity in hypermedia narratives, particularly devoted to include audio and video, not only must the internal qualities of the textual object itself be considered, but it is also necessary to include the extratextual relationships of both object-action and subject-action, including different forms of subject-actions.

6. A Fifth Principle of Continuity Linking

Continuity linking is a transformation of continuity editing applied as a 'technical trope' in the different but related communicational (and rhetorical) environment of hypermedia on the Web. The 'linking' of object-actions with subject-actions and vice versa, and the relationship and oscillation *between* these various kinds of activity forms a kind of *inter-activity* that is crucial to the composition and development of storytelling which exploits the potential of hypermedia. Considering this relationship, we might call the fifth principle of continuity linking *activity continuity.*

Activity continuity may be tentatively offered as a principle. As yet, there are no formal established rules which, when followed, ensure continuity between subject-action and object-action. Experiments show that *activity continuity,* despite the interplay of reciprocal actions, is basically obtained by applying the other four principles of continuity linking for this end. A main focus of attention must be given to motivate the user for the shift, and this again is achieved by exploiting semantic elements in the system itself. Any element that signals the shift is important, from the layout of the link anchor to the inventory at the story-level. [6]

7. Conclusion and Further Research

Continuity editing has been criticised for hiding the actual manufacturing of film by seamlessly masking the editing of shots. That might be a valid critique of a well-established media form. However, faced with the infancy of interactive multimedia and hypermedia, it seems more important at this stage to first put the medium together before taking it apart critically. A combinantion of experiments and analysis is necessary to develop this fifth principle of continuity linking into a valuable technique for improving the style and aesthetics of hypermedia and multilinear storytelling. It is rapidly becoming clear, however, that the best examples of this might not be found in attempts of the hypermedia tradition on the Web, but rather in the 3D environments of computer games. The computer medium itself contributes a unique information type to the multiple media environment of dynamic 3D. In computer games this representational form is already dominant. Further, because of the complexity and ability to include and represent all the other information types within such dynamic 3D environements, the problems of static and dynamic, subject-action and object-action, are reconfigured in challenging and interesting ways. That is another story...

8. References

1. Brøndmo, Hans Peter and Glorianna Davenport (1990) 'Creating and Viewing the Elastic Charles' in Ray McAleese and Catherine Green (ed.) *Hypertext. State of the Art,* Oxford: Intellect; Liestøl, Gunnar (1994) 'Aesthetic and Rhetorical Aspects of Linking Video in Hypermedia' in Proceedings of the ACM Hypertext 1994 Conference, Edinbrugh.

2. Nelson, Theodor Holm (1970), 'Getting it out of our system' in *Information Retrevial: A Critical View*, pp 191-210.

3. Bordwell, David and Kristin Thompson (1993) *Film Art* 4th Edition, McGraw-Hill.

4. Bøgh Andersen, Peter (1997), 'Film og multimedier' i Fibiger, Bo (ed) *Design af Multimedier*, Aalborg Universitetsforlag.

5. Landow, George P. (1997) *Hypertext 2.0. The Convergence of Contemporary Critical Theory and Technology*, Johns Hopkins University Press.

6. Examples of activity continuity cannot be shown in a static medium such as this paper. During my conference presentation examples will be *shown* based on the material of Thor Heyerdahl and The Kon-Tiki Museum.

Web-based Distance Education:
Faculty Recruitment and Training

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Abstract : Web-based Distance Education requires skills that transcend traditional teaching methods and most faculty currently employed in higher education do not possess these required skills. An aggressive strategy of training and recruitment is required to create a professoriate which possesses the wisdom of traditional faculties and the technological skills required to effectively communicate in the future. This paper examines the \need for changes in higher education staffing, identifies obstacles to those changes, and proposes strategies for overcoming those obstacles.

Introduction

As we move forward toward the new millennium, pressure for changing roles among faculty is a significant predictor of the attention that must be given to the planned preparation of those faculty. Few individuals, however, have examined faculty recruitment and training issues for Web-based distance education specifically. Yet, this topic is of intense interest to practitioners, researchers and administrators alike as higher education struggles to transform itself in a market sensitive manner. The role of Web-based distance education in this change is an important area to examine.

Faculty Recruitment

Traditionally, faculty have been hired to work on a campus or in a school building. This often required a deep financial and logistical commitment on the part of the organization and the individual to develop and sustain a relationship. Universities and colleges have historically treated faculty hiring as a decision with a significant and long term impact on the educational direction of the academic unit. Hiring a full-time faculty member was as much a philosophical decision about programmatic futures as it was a personnel action. Employment was not an action entered into lightly by either the institution or the individual. Adjunct professorial hiring added some flexibility to the activity of faculty recruitment, but the pool was usually limited to local talent. In non-metropolitan areas, finding qualified adjuncts was at least difficult, if not impossible.

Web-based distance technologies and alternative paradigms of distance learning create exciting new possibilities for staffing. Although universities have been hesitant to exploit these possibilities, a number of options are inherent in the larger pool of talent made accessible to institutions of learning.

- Distance technologies make it possible to record and/or distribute expert knowledge in ways which expand upon the use of traditional books and papers.
- Web-based text, graphics, online conferencing software, streaming audio and streaming video make dynamic expert knowledge accessible to not only appropriately equipped classrooms, but thousands of remote sites, including homes and offices.
- Courses can be conducted and managed by part-time faculty even if they live hundreds of miles away.
- Remote access benefits full-time faculty directly by offering greater flexibility when they need to be away from campus for field research, conferences, or other travel reasons.

- Additionally, these approaches can be combined in collaborative teaching models to permit faculty from multiple campuses to teach together to a group composed of representatives of each home campus and others.

Even when they are hired on a very limited basis part-time content experts greatly enhance the knowledge base available to any program of study. Consequently , the demand of market forces is prodding a gentle exploration of these innovative ideas in spite of the uncertainty of university reward and recognition structures.

The new talent pool evolving from Web-based distance technologies creates opportunities for innovative recruitment strategies and options (Marquardt & Kearsley 1998). All institutions, even those that are small and remote, can advertise nationally for expert faculty to expand or complement their core faculty resources. Recruitment can be designed to attract faculty to teach entire courses or special modules, which only require modest time and effort, but special expertise. A more diverse faculty can be attracted to cover topics from a unique regional, cultural, or ideological perspective. Retired faculty can continue to participate in the life of the university as they are needed, and as they desire, from wherever they may have relocated. Large numbers of students in one class can be managed by one regular faculty who manages the course and others who contribute their special expertise and share the load for interactivity and evaluation. Some faculty can be hired exclusively for course design, while others are hired for instruction. Whether the model is individually oriented or team oriented, distance technologies mean that a more diverse, better qualified, more talented, and flexible pool of potential faculty can become available to all institutions.

The net result of more faculty and more institutions vying for their participation will be more competition. Institutional loyalty and proximity are still factors in faculty decision making, but incentives will become increasingly important especially as a professional group of free-market distance educators emerges. Institutions that wish to recruit the best and the brightest faculty will be well advised to follow traditional lessons in the context of a new reality. Faculty teaching at a distance will not be enticed by a move to a cultural center or research facilities, they are more likely to be enticed by a situation which provides them a great deal of flexibility. They may be motivated by an institutional affiliation with an institution renowned for excellence in traditional and distance programs, but they will certainly be motivated by those institutions with the most interesting curriculum options, best support services, and most enticing compensation packages. Regardless of the reputation of an institution, a recruiting strategy which attracts high quality faculty who are available, skilled, and willing to follow institutional policies is essential and must be carefully planned and executed.

Obstacles to Recruitment Success

Even a willing and capable workforce will not eradicate a bevy of serious and contentious issues which will continue to plague efforts at academic reform. Strategies such as those outlined above will conflict with traditional wisdom and practices of most higher education institutions. First among these are the dual problems of promotion and tenure. Most institutions do not have clear policies which address the decision weight for the significant efforts required for development and delivery of web based learning materials. This ambiguity will continue to be a disincentive for many non-tenured faculty to participate in web based learning activities. Experienced and tenured faculty will likewise be deterred by the threat to job security posed by a recruiting strategy which focuses on performance criteria not general institutional status. Furthermore, what is to be done if there are tenured faculty who refuse to perform web-based teaching activities or who perform poorly when asked to do so? Will faculty roles be differentiated based on ability? Will faculty work in teams?

Special work agreements with performance specifications and the necessity of course and faculty evaluations for purposes of quality assurance with part-time faculty, will also threaten some traditional notions of academic freedom. There are also concerns that a few high profile – high status faculty may dominate the instructional world of the web as an academic superstars; thus, attracting most students to their course to the detriment of other arguably superior learning opportunities. Also of interest is how intellectual property and compensation decisions will be adjudicated when intellectual wares may go to the highest bidder.

Faculty Training

Large and financially affluent institutions will have an advantage in recruiting not only the most knowledgeable faculty, but also the most skilled at Web-based distance education. Nevertheless, recruitment alone will not suffice in creating a faculty prepared for a web based learning environment. All educational institutions will need to commit to faculty training as a core part of their academic activity. While some education and training can be delivered at a distance by even the uninitiated, normal communications skills are inadequate to achieve effective learning results across the diverse methods of distance education.

To achieve a high performance solution, it is imperative that a systematic approach be applied to the planning and development of distance learning materials, instructional methods, and communications infrastructure (Laney 1996). It is precisely because learners and faculty are physically separated in a web-based learning environment, that course structure and materials must be developed in a systematic manner that reduces the possibilities of misinterpretation and confusion. Traditional course preparation efforts range dramatically among higher education faculty. Many faculty prepare little more than a topical syllabus and allow lessons to emerge from classroom interaction coupled with the personal expertise of the faculty. Other faculty prepare learning objectives, activities, and materials, but few have training in these endeavors. These traditional approaches are not sufficient to engender high quality web based instruction.

In general, the best technique for learning to use distance education technologies is practice. Skill development evolves over time in real life situations. It is a good idea to have faculty participate as learners or observers in settings which use distance education strategies, then have them contribute information or lessons to an existing class. Finally, allow new distance faculty to design and develop a lesson without the pressure of having to deliver the actual lesson. A great deal will be learned by actually going through all the steps involved.

Generally, new faculty need to learn how to establish and maintain contact at a distance. They should attempt to create situations in which they reach out to the clients personally as though they were writing a letter. They should think about engaging the clients and communicating to them by anticipating their questions and confusion. Finally, new faculty should determine how they can best evaluate learning in a distance context. The signs are different, but the students' needs are the same. Obviously, the institution should provide as much help and support as possible to these efforts on the part of faculty, but it is the individual that must do the thinking.

Videotape for asynchronous Web-based delivery involves some kind of studio or field production of a presentation, electronic field trip, or demonstration and variations on these themes for delivery to clients to view at their convenience. Faculty should watch several examples of high quality examples (within the production guidelines of the institutional producer) to begin conceptualizing the kind of production that can and should be accomplished. Next the faculty should work with a director to create several simple samples of on camera work, listening carefully to the director' s advice. The samples should be reviewed with the director and redone for comparison purposes. Finally, some samples should be created and shared with colleagues and students for feedback. The production guidelines for each institution will dictate a good deal about what can and can' t be done, but these should always be stretched in the interest of good quality instruction.

World Wide Web based text with graphics for asynchronous delivery is the distribution of HTML documents through the Internet for remote viewing and reading. Skill development with the World Wide Web is different that with video production; most important for faculty is the ability to plan and design learning resources that work well within a hypertext and hypermedia environment. This is most efficiently accomplished through the use of an instructional designer or similar support person. Faculty may also want to develop skill in HTML coding, in order to quickly update documents and add resources. HTML knowledge is not essential, but should be provided as a support resources by the institution for document creation.

Computer based conferencing for asynchronous delivery is the use of a computer based system for communicating through the use of electronic mail, newsgroups, or web based conferencing. Almost all faculty now use some form of electronic communications for sharing information. There are techniques that need to be developed to make this work effectively. Most important is the development of a careful communication style that does not inadvertently offend. It is also essential that skills in file transfer and attachment be developed as well.

Faculty are not likely to seek out assistance in learning these techniques without some motivation and encouragement by the institution. It is imperative that institutions establish a comprehensive faculty development program and require those faculty who want to participate in distance learning to participate. Faculty with well developed skills and experience will work with confidence and effectively represent the institution.

Obstacles to Training Success

Training to enhance specific job performance and skill development for a changing workplace are not easily accommodated in higher education settings. Faculty have traditionally been difficult to train for a variety of reasons; status, ego, self-confidence, and job definition are among them. Training and human development have been designated as activities best suited for staff. Attitudes are changing among faculty who see skill enhancement as a means to an end, but there are many who perceive that participation in training initiatives as the first step in changing faculty roles. Faculty roles are changing rapidly; it is imperative that training programs position themselves as opportunities for faculty survival and not vehicles for faculty demise.

Many faculty are also reluctant to be trained in the midst of their peers for fear of embarrassment. This is especially true in technical areas where foundational knowledge and prior experience are prerequisites to rapid and successful learning. Consequently, many faculty desire individualized instruction which is expensive and often impossible to provide for everyone. Screening and confidence building activities are key strategies to training success. Activities should also provide tangible and immediate benefits to the lives of faculty participants. Nothing breeds success like prior success.

Human and equipment resources are only part of the limitation in delivering successful training experiences to faculty. Faculty in higher education have a range of responsibilities which create unusual schedules; it is difficult to find a time that meet the needs of a large number of faculty, especially during the academic year. Even when scheduling can be accomplished, situations of demand that faculty set priorities on their time and training opportunities usually come last. Identifying special high profile training opportunities during non-peak times, especially summer will provide some relief, but generally planning well in advance is the best strategy.

As with any group, faculty also come to learning opportunities with a diverse set of personal and professional goals and needs. For example, some faculty may want to know 'how to' do everything necessary to design and create a website for an on-line course; others may want to provide references on-line to supplement on site instruction. These are both appropriate goals, but with radically different training experiences and time commitments attached. Trainers must be sensitive to the needs of each in structuring learning experiences. In addition to diverse goals, faculty may have different learning needs as well, some will come with a lot of prior knowledge and experience, others with very little. It is extraordinarily difficult to meet the requirements of each individual; but training that is too generic may not meet the needs of anyone. It is imperative that faculty be screened for prior knowledge; training can then be designed at an appropriate level for an individual or group of faculty.

In addition to diverse goals and learning needs, faculty members also tend to lack a common culture of pedagogy. The structure of academic disciplines, prior teaching and learning experiences, culture background, general philosophy of life and formal pedagogical training all contribute to a faculty member's view of the teaching and learning process. Distance and mediated learning in general and web-based learning specifically, compel a systematic examination of our pedagogical underpinnings, but old and successful teaching methods don't yield easily.

May organizations find that equipment available for training is not available on faculty offices or home equipment. This is a daunting limitation. If faculty cannot practice and implement what they have learned, their interest, knowledge, and skills will soon atrophy. Efforts should be made to provide appropriate equipment to faculty who will use it, perhaps as a reward for successful training. If this is not an affordable alternative, then a facility with all appropriate equipment and staff should be provided as a central resource exclusively for faculty. Such a facility will permit faculty more resources than normally possible on the desktop and a retreat from interruptions.

Faculty Development Case Study: The Instructional Technology Laboratory

The Instructional Technology Lab was established in August of 1997 to provide the George Washington University faculty a resource to assist them in appropriate and desirable uses of instructional technologies. The ITL has evolved to offer a range of support services to the faculty that aim to effectively integrate instructional technologies into the academic program based upon a strong pedagogical foundation. Staff specialists in the ITL have instructional design, interface and graphics design, and teaching experience in traditional and mediated learning environments.

Physically, the ITL is an open environment that provides direct access to professional staff and equipment for faculty working on multimedia projects, redesigning curricula, or learning about new technologies. A complement of state of the art audio, video, and computer equipment provides faculty access to otherwise unavailable or expensive equipment. Designed for both group and individual faculty training, the physical composition of the ITL fosters cooperative project-oriented experimentation and development with a range of instructional technologies.

The earliest developmental stage of the ITL focused on development of the lab facilities. The lab supports computer, video, audio, and staff resources in a collaborative work environment. Faculty members are assisted in the creation of compelling, effective and high quality multimedia presentations and course materials.

The second stage of the ITL's development combined ITL facilities with technical workshops and presentations utilizing the computer labs, computer classrooms, and seminar rooms elsewhere on campus. Demonstrations of new technologies, emerging theories of learning and instruction, and different teaching strategies are organized and presented by ITL staff in coordination with other university units. Armed with this knowledge, faculty acquire an intellectual foundation as well as practical experiences with which they continue working with ITL staff to implement appropriate technologies into their teaching.

In responding to faculty needs, new opportunities have emerged to engage and work with faculty as they develop instructional technologies. One area of focus lies in online courseware tools. A system originally developed in the ITL and now being extended to the entire university community is *Prometheus*. This product allows faculty to easily create and manage Web based courses and course materials for both traditional and distance students. While courseware tools can facilitate and assist in Web based instruction, the ITL views its role as assisting faculty in determining why, when, and how to use this and other tools in an effective manner overcoming the relatively simple goal of 'getting my course on the Web'.

Recently, the ITL has been focusing on improving faculty development through a more systematic and proactive strategy. In cooperation with other university departments the Summer Intensive Workshop Initiative (SIWI) was created. This project draws on staff expertise and resources to provide faculty with an intensive 3 day series of workshops and seminars on teaching and learning with instructional technologies. The initiative seeks to provide specially tailored opportunities to faculty based on their skill level. In addition to the focused and intensive workshops, the SIWI effort includes follow-up support as faculty apply their new skills. Staff from the Instructional Technology Lab work individually with faculty on problem definition and project planning in addition to instructional design and technical support. The SIWI program has at its core an ambitious series of evaluative measures and plans call for a wider evaluation of the effectiveness of faculty use of instructional technologies in the classroom. In addition to the intensive workshops and follow-up support, the ITL is working to implement a grant program that will provide faculty with fiscal resources to accomplish their course development goals.

The ITL seeks to provide the university faculty with pedagogical, as well as technological, activities and projects that support high quality learning. To this end, the ITL staff constantly seek to improve their services and respond to faculty needs. Future projects of the ITL will include a metropolitan area symposium on effective uses of instructional technologies, an electronic journal focusing on faculty projects and successes, and the addition of fee based course design, technology integration, and materials development services. These efforts and future projects will focus attention on pedagogical issues and reflect the ability of the ITL staff to think 'outside the box' while providing custom solutions and approaches to complex instructional challenges.

Conclusion

As Web-based distance education continues to rapidly grow in popularity the issues of faculty recruitment and training are moving to the forefront of items that need to be addressed. Recruitment and training of faculty to teach in Web-based distance education environments differs from recruitment and training of faculty to teach in traditional environments.

References

Laney, J. (1996). Going the distance: Effective instruction using distance learning technologies. *Educational Technology*. March-April, 1996.

Marquardt, M. J. & Kearsley, G. (1998). *Technology Based Learning*. CRC Press LLC.

Assessment and Comparison of Web-Based Educational Environments

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Abstract: *The World Wide Web (WWW) has considerable potential for delivering distance education programs. New software tools are being developed to facilitate the authoring, delivery and management of Web-based courses. In this paper, we perform a detailed assessment of five such Web-based educational environments, namely WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc. We base our evaluation on experimentation and practice with these tools.*

1. Introduction

Tele-Education on the WWW can enhance the traditional way of teaching and offer new learning experiences to the students. However, there are many questions to be answered, for example how well a formal educational system can be delivered over the Web, will there be any human contact or communication, what are the benefits of Web-based education, etc. Recently, many Web-based educational environments have been developed. These software tools help in the development and authoring of courses, the delivery of the courses over the Web, the secure access of the course material by the students and the instructors, the automatic grading of exams, the student performance tracking and reporting, the statistical analysis of the student performance and the course material usage. Some popular software tools that facilitate the creation of sophisticated Web-based educational environments are the following: WebCT [WebCT], TopClass [TopClass], LearningSpace [LearningSpace], Virtual-U [Virtual-U] and LearnLinc [LearnLinc].

It is difficult to conclude about the best product because some are better in a particular feature area, while others in another feature area. Furthermore, every day new products and new versions of the already existing products appear. Bruce Landon [Landon 1998] compares many software tools such as WebCT, TopClass, LearningSpace, Virtual-U, Web Course in a Box, CourseInfo, FirstClass, PlaceWare. He concludes that WebCT, TopClass and LearningSpace are the best, with a slight superiority of TopClass. LearningSpace precedes the others in the synchronous collaboration features. It is important to mention that the synchronous communication abilities of LearningSpace are due to the DataBeam Learning Server, a Web-based educational product by Lotus Company. Sharon Gray [Gray 1998] surveys many software tools and concludes that LearningSpace is the best followed by WebCT and TopClass V2.0.2. Gray mainly focuses on the area of collaboration tools in which LearningSpace is a step ahead. Gray also points out the importance of WebCT for its feature of detailed student progress report and TopClass for its auto-testing feature. Herb Bethowey [Bethowey, 1997] concludes that TopClass is an easy to use software tool with extensive features for interaction between student-to-student and student-to-instructor. He also suggests LearningSpace as an excellent collaboration tool, with excellent course administration. Some other papers [Iowa 1997], [DBCC 1998], [Manitoba 1998] and [Uiterwijk & Seoane 1998] also analyze and compare Web-based educational tools, with LearningSpace, WebCT, TopClass and Virtual-U to be the most promising for Web-based education. University of Manitoba compares the three important software tools (LearningSpace, WebCT, TopClass) and the authoring tool ToolBook II. The survey concludes that WebCT has many capabilities for an integrated educational environment with TopClass and ToolBook II coming next.

In this paper, we analyze and compare WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc. We evaluate the most recent versions of these products. Although LearnLinc has not many features, we evaluate it because it is a new powerful integrated program with superior characteristics for synchronous education. We provide a comprehensive table with all available features for the evaluated tools.

2. Web-Based Educational Environments Presentation

In this section, we present five popular Web-based educational environments to which we have ended up after extensive investigation: WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc.

2.1 WebCT

WebCT [WebCT] is an easy to use environment for creating web-based courses without need to know programming. We have built online courses easily with the use of event-driven buttons. Only few times it was necessary to interfere with the course page's code in order to add advanced functions or modify slightly the existing features. WebCT was developed to support self-guided online courses. It supports high security as it is installed over the Apache Server. The Apache Server helps us to control the user's access and to secure the course material and framework from the hackers. We found out that the Internet Explorer is incorporated better than Netscape Navigator. WebCT also provides conferencing system, on-line chat, student progress tracking, group project organization, student self-evaluation, grade maintenance and distribution. Moreover, it provides access control, navigation tools, auto-marked quizzes, electronic mail, automatic index generation, course calendar, student homepages, course content searches and much more. WebCT gives the ability to the students to create their personal Web Pages allowing them to display their homework or any other information.

2.2 TopClass

Working in conjunction with web and media servers, TopClass ver. 3.0 [TopClass] provides scalability with sophisticated tracking and security. TopClass Server delivers courses and tests to any user connected through Intranets or the Internet. It also supports collaboration and discussion-group. It can use Oracle as a data store for training content, recording testing and tracking information. This option helps us to support more sophisticated reports and align management and backup procedures with other enterprise systems. It also supports the use of authorization information on Windows NT networks to identify users and eliminate additional login steps. It is certified to be Year 2000-compliant. Other utilities include the Player for off-line viewing and the Converter for automatic translation of MS Word documents or Web-based training content into complete TopClass courses. TopClass Player is a useful utility program, especially in remote locations where we can not afford the cost of online viewing. We only have to pay for the time being connected to the Internet in order to transfer the course content in our PCs. After finishing this transfer, we log off and continue our training in an offline viewing avoiding the connection's costs. The Creator lets us combine any web-compatible content into learning modules. The Assistants convert all documents and MS Office 97 presentations into complete courses. The Analyzer keeps track of usage, gathers feedback, and provides data for return-on-investment analysis. An advantage of TopClass Server from the other tested tools is the ability to convert instructor's material from a *.doc* or *.html* or even *.ppt* format into a customized course format to be displayed to the students. This function facilitates the instructors to build a course without the need to know programming.

2.3 LearningSpace

LearningSpace 2.5 [LearningSpace] is the latest release of Lotus solution for creating and delivering collaborative distributed education and training. LearningSpace runs on the industry-leading Domino Web Server, so it provides outstanding flexibility, advanced security and scalability. It does not require programming or technical skills. Templates help us to shape course content quickly and easily. LearningSpace transforms courses with cutting-edge video, audio and graphics, supports team learning and collaboration, manages courses and controls enrollments. It also provides private areas for discussions, assignments, grades, or confidential information. Furthermore, LearningSpace is becoming more powerful by collaborating with the DataBeam Learning Server. This results to a more integrated solution, enhancing the program's functions (Audio and VideoConference, Whiteboard and Application Sharing). An important function of this collaboration is the Application Sharing, which help us to share an application and to work in-groups effectively.

2.4 Virtual-U

Virtual-U [Virtual-U] is a server based software system that enables customized design, delivery, and enhancement of education and training courses. We can support group communication and collaboration in a secure newsgroup-style setting. Also we can easily set up collaborative groups online and define structures, tasks and objectives. A user can learn to moderate conferences and to create sub-conferences. Virtual-U enables us to organize course resources into a flexible online course syllabus without programming knowledge. These resources can include downloadable files, course texts, relevant Web links, assignments and any type of multimedia file. It automatically places the course syllabus on the Web for access by all students enrolled in that course. Virtual-U includes functions such as creating and maintaining student accounts, defining access privileges and establishing courses. Administrators can also perform batch imports of class lists from existing registration data.

2.5 LearnLinc

LearnLinc [LearnLinc] was the first live online learning classroom to support multimedia-authored courseware, allowing CBT quality synchronized content. It provides a simple user interface allowing us to configure features and presentation materials for students. It also supports full duplex audio and two-way videoconferencing with Intel ProShare 500. LearnLinc's Floor Control lists student names alphabetically, or in hand raises order allowing us to choose students easily to call on. Also it enhances our communication using videostreaming for one-way delivery of live or pre-recorded audio and video. LearnLinc's Synchronized Web Browser supports full functionality. LearnLinc supports Application Sharing for full interactivity. Moreover it contains a Question & Answer feature, to allow the instructor to write and launch questions before class or on the fly during a class and a Text Chat that allows private messages to be sent to the instructor by a student. Its Shared Whiteboard allows any file or image to be pasted-in as an object. LearnLinc is suitable for real time distance education. However, it does not include all the appropriate functions to simulate a traditional classroom.

3. Comparison Criteria

In this section, we analyze the criteria that we use in the comparison of the Web-based educational environments. The following criteria are the most important in order to make a comprehensive and extensive assessment of these educational environments. We can classify these criteria according to their related features [Mamoukaris & Economides 1999] in: technology features, administration features, student features, instructor features and communication features.

Criteria that are related to the technology of the tools include the required RAM, Platform Independence (operating system), Access from Internet or LAN, Web-Browsers, ability to refer to an Universal Resource Locator, Internal e-mail to registered users, External e-mail to non-registered users, Video, Audio and Database (internal database and external database cooperation).

Criteria that are related to students such as off-line Viewing (the ability to view a course without being connected to the Internet), Friendly User's Interface, Annotations (students keep notes near the course material), automated Index, Text-Search, Learning Goals.

Criteria related to administration features' concern the Security levels and Crash recovery tools that restore the course content and related information without loss of data from communication or server hardware failure.

Communication and Collaboration related criteria include Discussion Area to support asynchronous threaded communication, Audioconferencing, Videoconferencing (broadcasting video to users without a video input device), Bulletin Board (downloading and uploading/posting files over the Web), Chat (exchange of text in real time), Whiteboard (shared text window that may also support shared drawing), Application sharing (run an application on one machine and share the window view across the Web).

Criteria related to assist the instructor include Remote authoring & administration of courses, Customization features for Welcome Page, Customization features for the courses, Building motivation (adapting the display of the course content to the user's preferences), Syllabus (automatic creation of a page with the contents of the course), Creating Actions (provide the student with extra material depending on test's results), Language for advanced functions, Questions Pools (repositories for questions), Import/Export Courses, Import a course with a .doc format (from Word), Import a course with a .ppt format (from PowerPoint). Additional criteria concern the

Access Control to prevent unauthorized access to the courses or to the program. Restrictions for the course material or the access time, Testing, Number of question types, Submission and Auto-Correction of tests and Reports of user's progress. Also, criteria related to the friendliness and easy of use of the tool include the requirement for Knowledge of HTML, Friendly Designer's Interface, Glossary that will help the designer to automatically specify a list with keywords and their definitions.

Finally, Price comprises another critical factor to our comparison. However, there are many differences in the way every product is priced. For example, the cost of WebCT, LearningSpace and Virtual-U refers to 100 users per one course. On the other hand, TopClass and LearnLinc calculate the cost for 100 simultaneous users (there may be many more registered users than those participating at a specific moment) and for a large number of courses per user (not just one course).

4. Comparison Results

Based on our practice and experience with WebCT, TopClass, LearningSpace, Virtual-U, LearnLinc, we present the following Table:

Criteria	WebCT	TopClass	LearningSpace	Virtual-U	LearnLinc
RAM	32MB	32MB	64MB	24MB	32MB
Platform Independence	W, U	W, A, U	W, U	W, U	W
Access from Internet or LAN	Both	Both	Both	Both	Both
Web Browsers	Yes	Yes	Yes	Yes	Own Environment
Universal Resource Locator	Yes	Yes	Yes	Yes	Yes
Internal E-mail	Yes	Yes	Yes	Yes	Yes
External E-mail	*	Yes	Yes	No	Yes
Video	Yes	Yes	Yes	Yes	Yes
Audio	Yes	Yes	Yes	Yes	Yes
Database	Yes	Yes (Oracle)	Yes	Yes	Yes
Access Control	Yes	Yes	Yes	Yes	Yes
Restrictions for the courses	Yes	Yes	Yes	Yes	Yes
Testing	Yes	Yes	Yes	Yes	Yes
Number of questions types that supports	5	7	-	-	1
Submission and Correction of test	Yes	Yes	Yes	Yes	Yes
Report's of user's progress	Yes	Yes	Yes	Yes	Yes
Knowledge of HTML	No	No	No	Yes	Yes
Friendly User Interface	Yes	Yes	No	No	No
Friendly Designer's Interface	No	Yes	No	No	No
Glossary	Yes	No	No	Yes	No
Off-line Viewing	No	Yes	No	No	No
Annotations	Yes	No	Yes	Yes	Yes
Index	Yes	Yes	Yes	Yes	-
Text-Search	Yes	Yes	Yes	Yes	-
Learning Goals	Yes	No	Yes	Yes	No
Discussion Area	Yes	Yes	Yes	Yes	Yes
Audio-Conferencing	No	No	**	Yes	Yes
Video-Conferencing	No	No	**	Yes	Yes
Bulletin Board	Yes	Yes	Yes	Yes	Yes
Chat	*	No	No	No	Yes
Whiteboard	No	No	**	No	Yes
Application Sharing	No	No	**	No	Yes
Remote authoring & administration of courses	Yes	Yes	-	-	-
Customization features for Welcome Page	***	Yes	Yes	***	***
Building Motivations	No	Yes	No	No	No
Customization features for courses	Yes	Yes	Yes	No	No
Syllabus	Yes	No	Yes	Yes	Yes
Creating Actions	Yes	Yes	Yes	Yes	Yes
Language for advanced options	No	QML	No	No	No

Criteria	WebCT	TopClass	LearningSpace	Virtual-U	LearnLinc
Question Pools	No	Yes	Yes	No	No
Import/Export Courses	Yes	Yes	Yes	No	Yes
Import a course with a doc format (from Word)	No	Yes	No	No	No
Import a course with a ppt format (from PowerPoint)	No	Yes	No	No	Yes
Crash Recovery Tools	Yes	Yes	Yes	-	-
Price (see price criteria)	$500 for 100 users	$3,750$ for 100 users	$1,000 for 100 users	$3,500 for 100 users	$500 - $1,000

Table 1: Comparison of the educational environments

Price example: $500 for 100 users of WebCT, $3,750 for 100 users of TopClass, $1,000 for 100 users of LearningSpace, $3,500 for 100 users of Virtual-U and $500 - $1,000 for users of LearnLinc. In the table W means Windows, U - Unix and A - Apple. Also the symbol "*" means *Some Problems* appeared during experimentation. The symbol "**" means that LearningSpace provides Audio and VideoConference, Whiteboard and Application Sharing by combining its features with DataBeam Learning Server's features and "***" means that these products do not offer the ability to the designer to customize the Welcome Page according to his preferences. The graphics at the Welcome Page cannot been modified. Finally the symbol "-" means *Not enough information.*

5. Conclusion

There is a huge market for Tele-education over the Internet. Many software tools have been appeared that helps the delivery of courses over the Web. We evaluate five such popular Web-based educational environments and find out that each has some special features. The right choice depends on our preferences. LearningSpace is a powerful tool for collaboration and with the support of Lotus Domino Server provides a secure environment. LearnLinc is a very powerful software tool especially for conferences. In conjunction with DataBeam Learning Server it supports Video and Audio conferences and team-based conferences, but it is weak in supporting the online courses to the students. At present, we prefer TopClass and WebCT. TopClass provides a secure environment with different security levels and cooperates with the Oracle database. Its unique feature is that someone can download the course material, disconnect from the Internet and study the course offline with the help of utilities that accompany the program. In addition we can upgrade it by using tools such as IChat, and built a synchronous environment. Moreover, by incorporating the MS NetMeeting into it, TopClass can provide an integrated environment for Web-based education. WebCT has the advantage of an internal Chat environment, enhancing its functions with real time text communication. Additionally, WebCT's Chat offers a variety of forums for different thread discussions. An advantage of WebCT is the security due to the Apache Server. Apache Server is a powerful, widespread Web Server, which controls the access to the course content and prevents unauthorized access.

6. References

[Bethowey, 1997] Herb Bethowey, (1997). *Internet-based training tools run close race*. PC WEEK ONLINE, available online at http://www8.zdnet.com/pcweek/reviews/0818/18chart.html

[Iowa 1997] The University of Iowa, (1997). *Web-based Course Management Systems*, available online at http://www.uiowa.edu/~itisidg/

[DBCC 1998] Daytona Beach Community College (DBCC), (1998). Compare Web Tools for Course Authoring, available online at http://www.geocities.com/Eureka/Gold/6012/compare_web_tools.htm

[Gray 1998] Sharon Gray, (1998), *Web-Based Instructional Tools*, Syllabus Magazine, Vol.12, No 2, available online at http://www.syllabus.com/sep98_magfea2.html

[Manitoba 1998] The University of Manitoba, (1998), *Advantages and Disadvantages of Web Based Instruction*, available online at http://www.umanitoba.ca/ip/tools/courseware/pros.html

[Uiterwijk & Seoane 1998] Julie Uiterwijk and Dan Seoane, (1998), *Web-based training solutions*, InfoWorld Publishing Company, available online at http://www.infoworld.com/cgi-bin/display/TC.pl?980907comp.htm

[Landon 1998] Bruce Landon, (1998), *Features/Tools and Tech Info, Comparison Table for all Applications*, available online at http://www.ctt.bc.ba/landoline/spsall.html

[Mamoukaris & Economides 1999] K. Mamoukaris and A. Economides, (1999), *Important Criteria for Web-Based Educational Tools*, New Horizons in Industry and Education, Accepted

[WebCT] WebCT site: http://www.homebrew.com/

[TopClass] TopClass site: http://www.wbtsystems.com/

[LearningSpace] LearningSpace site: http://www.lotus.com/learningspace/

[Virtual-U] Virtual-U site: http://virtual-u.cs.sfu.ca/vuweb/

[LearnLinc] LearnLinc site: http://www.ilinc.com/

Collaborative Web-Based Learning in Organizations

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Abstract: The World Wide Web is an emerging platform for learning systems; yet the interaction modes of existing approaches are often restricted to the distribution of information resulting from the underlying protocols, which were designed for the representation and distribution of hypermedia information, not to support human interaction. We present a group interaction system that generically adds human interaction support to existing web-based learning systems. Consequently, cooperative forms of distributed learning become possible and continuous knowledge creation can be implemented.

1 Introduction

Rapidly changing environments generating new requirements create the demand for life-long learning – not only for individuals but also for corporations. As a result, there is a growing need to support new methods of learning. Web technologies particularly support the platform-independent distribution of and easy access to hypermedia information. Therefore, web technologies are also emerging as a platform for computer-based learning systems. However, even if hundreds of learners, teachers-, and tutors browse a learning site, every learner works on his or her own, so that this isolated mode of learning ignores all of the advantages of collaborative learning and is a serious drawback to the effectiveness and efficiency of the learning process.

The paper begins with a description in section 2 of web-based learning scenarios which profit from enhanced human interaction. A group interaction architecture and system (GIA) is introduced in section 3. A continuous knowledge creation process using GIA is described section 4. The paper finishes with notes on related work, conclusions and references.

2 Learning Processes in Organizations

Although traditional learning forms will continue playing a significant role in a company's training portfolio, the presented approach focuses on a special subset of all of the corporate types of study and training currently deployed: computer-supported, distributed, and cooperative learning in an organizational context. In addition to the presented focus, additional requirements arise from the learning context within a company:

- The learning needs are not predefined and may change quickly and fundamentally according to the employees' actual challenges. Often, the learning process is not continuous, e.g. in a new project team a (distributed) group of people have to learn the same content within an extremely short period of time.
- The courses must be tailored to the actual needs of the learners or their specific knowledge deficits.
- Frequently the knowledge is not concentrated but scattered throughout the organization. Experts ("teachers") for a specific topic cannot always be determined. If available at all, they lack the time required for teaching.
- Learners have an acute need for learning but not enough time to learn.
- And sometimes, learners have to - but don't want to - learn something (external motivation).

In the following, we present a brief introduction of the set of learning scenarios taken under consideration. This is followed by a scenario classification and an analysis of needs for human interaction.

2.1 Learning Scenarios

The following learning scenarios can serve as an incomplete, but interesting set of organizational learning forms. They should aid in deriving useful services of a system for cooperative learning.
Asynchronous Learning Courses are a well-established method of computer-based training. Often the courses are carried out with media-based asynchronous distributed learning systems. The learning content is represented on CD-ROM or can be downloaded from a media server over a network. A number of existing learning systems support this computer-based form of study.
Video-/Audio- based Lectures enhance asynchronous learning courses by means of synchronous multimedia communication and interactive presentation techniques. This can result in heightened learning performance as learners can ask any questions on the spot. Although the required network bandwidths are high, this learning form is already established in corporate distributed training.
Individual Training and *Training on the Job* are very efficient, individual and situation-based types of learning (and, unfortunately, expensive ones, too). The interaction rate of learners and tutors is extremely high. Common CSCW systems (CSCW, Computer-Supported Cooperative Work) could be used to support these new distributed forms of individual training.
Knowledge Markets are a learning and teaching form where knowledge is based on the metaphor of supply and demand. A basic feature is rewarding experts for transferring knowledge according to their colleagues needs. The interaction of learners and teachers is basically restricted to question and answers. No specific support systems are available for this scenario.
Information Searching is meant to describe an autodidactic form of learning, where knowledge deficits are set by searching for information in a comparatively large, but possibly also crudely structured and uncertain information space, such as the World Wide Web. Generally, human interaction is absent, often even not intended. Desired communication is often initialized through existing internet services such as email and processed outside the underlying hypermedia system.
Project-oriented Learning and Distributed Task Forces focus on supporting the learner in his or her actual working situation. The interaction of learners and tutors is a key success factor and should therefore be well supported. No specific support systems are available for this case.
Content-oriented Learning Groups describes a learning situation where learners share a common interest. The interaction of learners can be supported efficiently by existing CSCW systems (e.g. NEWS).

2.2 Scenario Classification

The presented learning scenarios can be classified based on the qualities of the learning content [Fig 1]. Possible questions include the following: Can the recipient of the knowledge have faith in the truth of the information or is the information source unsure? How well does the offered knowledge fit the learning needs of the learner? Are didactical aspects considered in the representation of the learning context? How much new knowledge is created in the learning process?
In a couple of interesting scenarios, human interaction is a prerequisite for learning success, and other computer-supported learning approaches profit greatly from human interaction. Nevertheless, many existing learning systems basically support knowledge distribution through web-based hypermedia services and human interaction through electronic mail. As we do not consider this to be adequate for all of the intended organizational learning scenarios, we present an improved approach for training and study in organizations: support collaborative learning by extending existing corporate web-based learning systems by the factors of awareness and group interaction on the learning web. In the following, GIA and its functions are described.

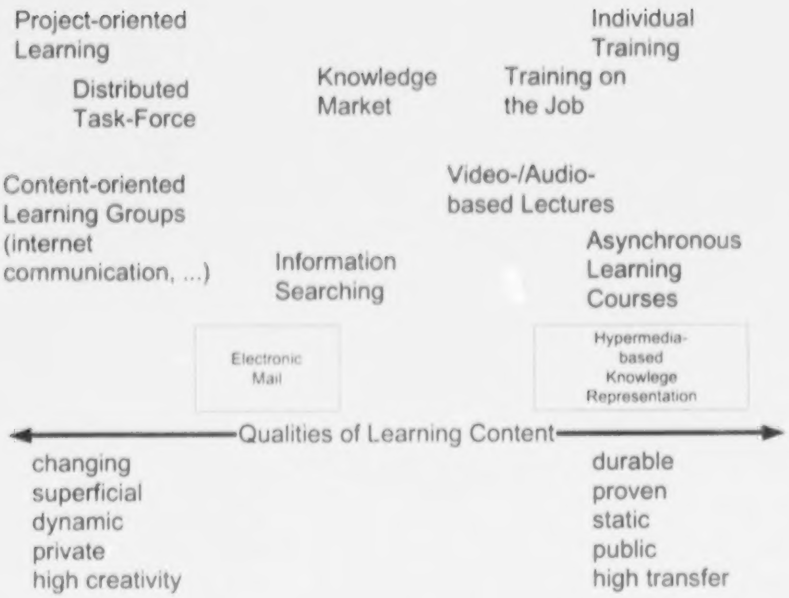
Project-oriented Learning
Individual Training
Distributed Task-Force
Knowledge Market
Training on the Job
Content-oriented Learning Groups (internet communication, ...)
Video-/Audio-based Lectures
Asynchronous Learning Courses
Information Searching
Electronic Mail
Hypermedia-based Knowlege Representation
Qualities of Learning Content
changing
superficial
dynamic
private
high creativity
durable
proven
static
public
high transfer

Figure 1: Classification of Learning Scenarios and Interaction Functions

3 The Group Interaction System GIA

3.1 Requirements

A system to support cooperative learning on the web has to fulfill a number of IT-oriented constraints, which are summarized in the following. In order to enable a sufficient number of customers to use the services, the system architecture has to be as *platform independent* as possible. As most of the users are not computer experts, an *intuitive user interface* has to be implemented. Meeting the expectation of professional users necessitates a *robust and high performance* system architecture. To increase the *attractiveness* of the learning site, user interaction has to be presented effectively and in an innovative fashion. The basic GIA functions and system architecture were designed to meet these requirements. They are described in the following sections.

3.2 GIA System Architecture

The GIA system is implemented as a web-based client-server architecture. The GIA client runs as a set of coordinated Java applets on the user's computer. The GIA server consists of a set of coordinated Java and third-party servers on the computers of the learning site provider. All the components are coupled through an asynchronous event system. The architecture was designed to enhance existing web-based learning sites with a minimum of effort and minimum constraints to the site design. For a more detailed description of the system architecture, see [Manhart et al. 1998].

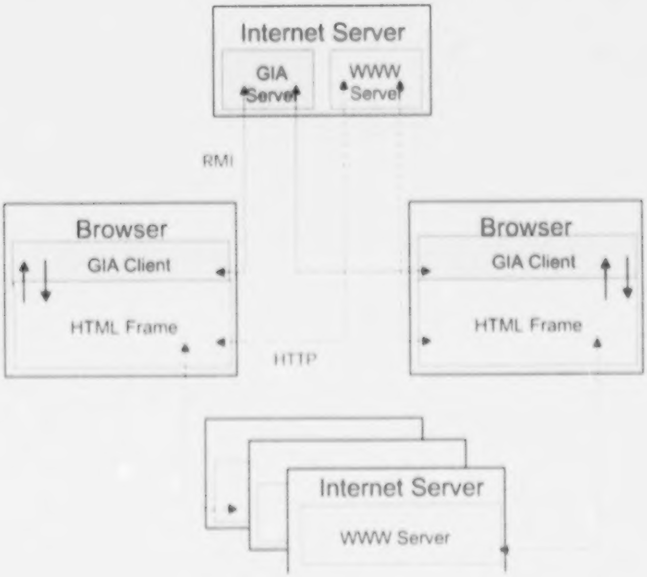

Figure 2: GIA Client/Server Architecture

3.3 Basic GIA Functions and Client

Currently, four basic group interaction functions are implemented in the GIA system:

1. *User Awareness:* While the learners or tutors are browsing the web site, they can recognize other users who share their location or subordinate sites [Figure 3, location map]. The web users are visualized in a room map metaphor. User awareness makes a learning site much busier and more attractive. It is also a prerequisite for meeting the people required to build learning communities, which is a comparatively efficient form of learning.
2. *Location Chat:* Users are grouped together with others who share the same location on the web. People sharing a group can communicate via chat [Figure 3, location chat]. If a customer moves to a different location, the location chat group changes to his or her current location.
3. *Cooperative Navigation:* Learners can link their browsers to other users [Figure 3, pop-up menu] who may be tutors or system administrators. In this way, individual advice can be given or interactive guided tours realized.
4. *Acquaintance Chat:* Chat groups which are independent from their users current location may be invoked. In the case of individual training, a learner can build a communication group with a member of the training staff and discuss open questions. Learners can also communicate and remain in contact via an acquaintance chat group.

These four basic functions are currently enhanced by location specific, NEWS-like discussion forums to also support asynchronous forms of communication. Just like the chat groups of the location chat, the GIA discussion forums are also coordinated with the user's navigation in the information space. Every time the user navigates in the web, the forum window automatically presents the appropriate discussion groups.

In contrast to existing web-based group interaction approaches, the GIA system coordinates its functions. The users are grouped according to their currently browsed content, and the related interaction tools are configured automatically by the system. This combination results in a generic, easy to use and powerful set of cooperation facilities.

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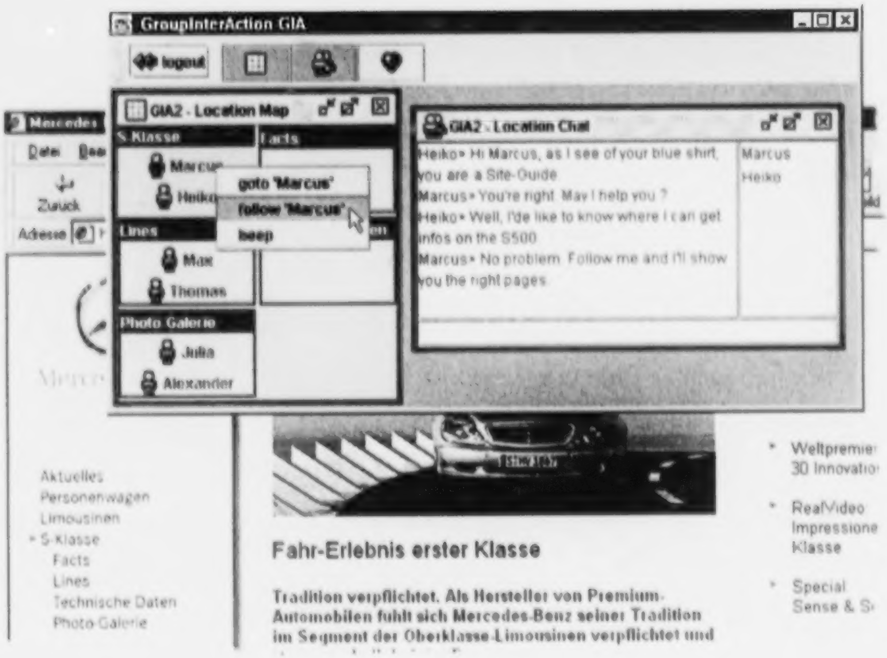
GroupInterAction GIA
logout
GIA2 - Location Map
S-Klasse
Marcus
Heiko
Facts
goto 'Marcus'
follow 'Marcus'
beep
Lines
Max
Thomas
Photo Galerie
Julia
Alexander
GIA2 - Location Chat
Marcus
Heiko
Mercedes
Datei
Zurück
Adresse
Aktuelles
Personenwagen
Limousinen
S-Klasse
Facts
Lines
Technische Daten
Photo Galerie
Weltpremie
30 Innovatio
RealVideo
Impressione
Klasse
Special
Sense & S

Heiko» Hi Marcus, as I see of your blue shirt, you are a Site-Guide
Marcus» You're right. May I help you ?
Heiko» Well, I'de like to know where I can get infos on the S500
Marcus» No problem. Follow me and I'll show you the right pages

Fahr-Erlebnis erster Klasse

Tradition verpflichtet. Als Hersteller von Premium-Automobilen fuhlt sich Mercedes-Benz seiner Tradition im Segment der Oberklasse-Limousinen verpflichtet und

Figure 3: Snapshot of GIA Client Applet

4 Moving Towards a Continuous Process of Creating and Improving Knowledge

One objective of deploying the GIA system for cooperative learning in the described scenarios is to support a more complete set of interaction forms and awareness. Another target of our approach is to provide a continuous process chain for the acquisition, structuring, processing and distribution of knowledge.

By adding content-related discussion forums to the pure hypermedia knowledge representation, we support the interaction of learners, teachers and tutors, as well as the interaction between the learners in relation to a defined, common content. In this way, questions and comments can be exchanged between all of the users involved asynchronously. The teacher or tutor can react to the learners' inputs by responding to the comments or by improving the content. New knowledge can be generated from finalized and founded discussion threads. If sufficient users are currently logged on, the web as well as the thread messages can synchronously be discussed in the location chat groups. Hence, a broad range of knowledge, from well-defined to vague, can be discussed in an adequate form of interaction.

The result is a learning situation that not only supports processing of predefined content but also improves available knowledge as well as creating new knowledge on the fly. The ensuing process chain consists of the three phases:

1. Collecting the available knowledge or the current demands
2. Structuring and consolidating new knowledge
3. Representing new knowledge in a didactic fashion and making it available.

Cyclic Processing of this knowledge creation, evaluation, and dissemination operations should result in the rapidly growing, well-evaluated, up-to-date and demand-oriented learning contents of corporate learning systems.

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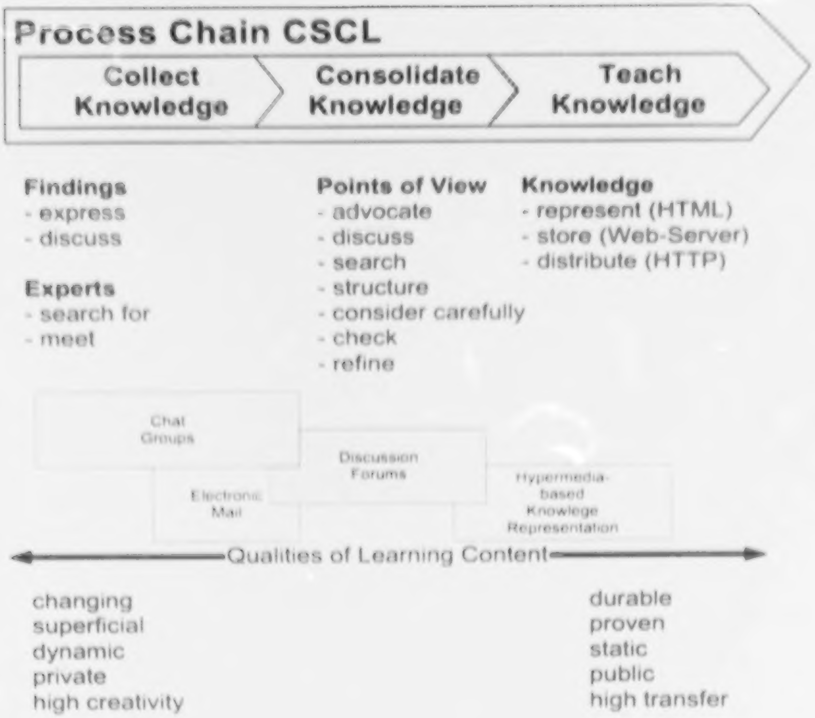
Process Chain CSCL
Collect Knowledge
Consolidate Knowledge
Teach Knowledge
Findings
- express
- discuss
Experts
- search for
- meet
Points of View
- advocate
- discuss
- search
- structure
- consider carefully
- check
- refine
Knowledge
- represent (HTML)
- store (Web-Server)
- distribute (HTTP)
Chat Groups
Discussion Forums
Electronic Mail
Hypermedia-based Knowlege Representation
Qualities of Learning Content
changing
superficial
dynamic
private
high creativity
durable
proven
static
public
high transfer

Figure 4: A knowledge Process Chain

5 Conclusions

We presented a set of new organizational learning scenarios that profit from the support of human interaction. These scenarios can be implemented through the web-based group interaction system GIA, which extends existing web-based learning sites by a coordinated set of computer-supported interaction functions. In addition to working towards a more efficient and effective learning process, we have developed the system to achieve a more continuous process of knowledge creation, discussion and distribution.

6 Related Work

User awareness is a main criterion for the support of group building and user interaction in groups [Fitzpatrick et al. 1996]. [Palfreyman & Rodden 1996] present WAP, a protocol for 'user awareness' in the web; yet they neglect to address the group aspect.

Together with the increasing amount of new knowledge and developments, a growing demand for organizations, groups and persons to augment knowledge and expertise has arisen. In the following, a few synchronous and asynchronous learning systems are mentioned:

"Answer Garden 2" [Ackerman & McDonald 1996] consists of a system architecture for asynchronous organizational memory and collaborative help support. Examples for synchronous learning are "GestureCam" [Kuzuoka et al. 1994], an approach that supports spatial workspace collaboration via a video-mediated

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communication systemand "CLARE" [Wan & Johnson 1994], which represents a collaborative learning system also enabling knowledge construction. In [Nakabayashi et al. 1995], several advantages of constructing an interactive educational system based on the Web are collected. [Benford et al. 1996] developed "The Internet Foyer", which provides awareness solely via the definition of a unified entry point, but which is a collaborative virtual environment not dedicated to learning.
Current commercial learning systems focus more on maximizing shared information, offer only uncoordinated group interaction support (e.g. global discussion forums, chat cafes, ...), restrict interaction structures to predefined relations (teacher-pupil), or do not provide any group support whatsoever.

7 References

[Ackerman & McDonald 1996] Ackerman, M.S., & McDonald, D.W. (1996). *Merging Organizational Memory with Collaborative Help*. ACM Conf. On Computer Supported Cooperative Work (CSCW). Boston, MA, USA.

[Benford & Brown 1996] Benford, S., & Brown, C., & Reynard, G., & Greenhalgh, C. (1996). *Shared Spaces: Transportation, Artificiality and Spatiality*. ACM Conf. On CSCW. Boston, MA, USA.

[Fitzpatrick et al. 1996] Fitzpatrick, G., & Kaplan, S., & Mansfield, T. (1996). *Physical Spaces, Virtual Places and Social Worlds: A study of work in the virtual*. ACM Conf. On CSCW. Boston, MA, USA.

[Kuzuoka et al. 1994] Kuzuoka, H., & Kosuge, T., & Tanaka, M. (1994). *GestureCam: A Video Communication System for Sympathetic Remote Collaboration*. CSCW'94. ACM Conf. On CSCW. Chapel Hill, NC, USA.

[Manhart et al. 1998] Manhart, P., & Schmidt, K., & Ziegler, H. (1998). *Group Interaction in Web-based Multimedia Market Places*. Annual Hawaii Int. Conf. On System Sciences. Hawaii, USA.

[Nakabayashi et al. 1995] Nakabayashi, K., & Koike, Y., & Maruyama, M. (1995). *An intelligent tutoring system on the world wide web: Towards an integrated learning environment on a distributed hypermedia*. ED-Media &ED-Telecom 95 Conference.

[Palfreyman & Rodden 1996] Palfreyman, K., & Rodden, T. (1996). *A Protocol for User Awareness on the World Wide Web*. ACM Conf. On CSCW. Boston, MA, USA.

[Wan & Johnson 1994] Wan, D., & Johnson, P.M. (1994). *Computer Supported Collaborative Learning Using CLARE: the Approach and Experimental Findings*. ACM Conf. On CSCW. Chapel Hill, NC, USA.

A Hybrid Architecture for Filtering Information on the Web

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Abstract. The system described in this paper has been developed with the aim of increasing the efficiency of Web Information Filtering processes and is based on a Case-Based approach. It currently acts as an intelligent interface for Web search engines. A primary characteristic of the system is its ability to adapt its filtering processes to a particular user based on the specific interests of the latter. This ability is achieved by means of a hybrid architecture, i.e., a sub-symbolic module integrated into a Case-Based reasoner. This dual component system serves to create and maintain individual user models that are stored in a library of cases for long-term reference of the system itself. The first experimental results of the system are encouraging.

1. Introduction

Nowadays, the Internet is the main route for information exchange world-wide: its growth and the World Wide Web makes it necessary for the end user to deal with the huge amount of information available on the net. Filtering information [Belkin, 1992] is a problem more and more relevant in information society. In this paper we present an Information Filtering system we have developed that selects HTML/Text documents from the World Wide Web. The system filters the documents according to the interests (and non-interests) of the user, as deduced by the system through the interaction. In order to do so, the system uses a User Modeling subsystem, particularly conceived for this task. One distinguishing feature of both components of the presented system is their hybrid architecture: a combination of a Case-Based Reasoner with a sub-symbolic module (here, an artificial neural network). In this paper we will focus on the Information Filtering Component. The system has been developed in Java on a Pentium II-based platform. The evaluation of the system is based on an empirical approach [Cohen, 1995] and makes use of a non-parametric statistics [Devore, 1995] for testing hypotheses on the system behaviour. The domain chosen for testing the system is the "computer science" domain.

This paper is structured as follows: in [The General Architecture] the general architecture of the system is presented. In [The User Modeling Component] we present briefly the user modeling component. In [The Information Filtering Component] we describe the anatomy of the Information Filtering component. In a concluding section we give some final remarks.

2. The General Architecture

The general architecture of the system is shown in [Fig. 1]. It is composed of the following modules:

- The *User Model*, representing the characteristics and the information needs of a particular user;

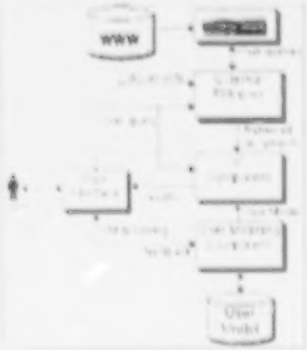
- The *User Modeling component*, capable of dynamically building the user model, as deduced by the system through the interaction;

- The *External Retriever*, which interfaces with AltaVista;

- The *Information Filtering component*, which selects the relevant documents for the user, according to the content of the User Model.

- The *User Interface*, which manages the interaction.

When a user interacts with the system for the first time, her/his user model needs to be made from scratch. For quickly building a reliable model an interview is proposed to the user, expressing an interest score for each of the domain categories (throughout all the system the values used are thought ranging from -1 (dislike) to +1 (like) if not otherwise specified).



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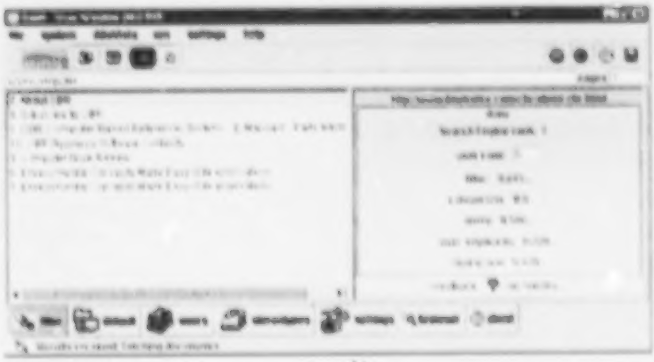

b)

Figure. 1: The Architecture of the System

Figure 2: The Query Interface

The user sets a query to the system that in turn posts it to the external WWW search engine, obtaining documents that are filtered and returned to the user. In the filtering process the systems works using two different levels of refinement: a first, coarse one, and a more elaborate step that takes place only if the first stage succeeds. During the normal usage the system offers a series of panels, being the first the filtering panel shown in [Fig. 2]. Here at the left is shown the list of documents retrieved by the search engine and selected by the system, given the user query and the User Model. Each document is detailed in the right panel, where the filtering results are also reported. The user browses the needed documents by double-clicking on them, and then he can express a simple feedback (as seen in the up-right window corner) among three different values: very good, good or bad, in order to ease the burden on the user, as recommended in [Morita & Shinoda, 1996]. In this way the system can modify her/his User Model accordingly to user's preferences. Furthermore, a system objects browser has been provided in order to allow the user to inspect all the system's data structures with an effective graphical interface to shorten the semantic gap between the user and the system. As said previously, this paper focuses on the Information Filtering component of the system. In the following [The User Modeling Component] we will only describe the main data structures of the User Modeling component.

3. The User Modeling Component

This component has already been used in a previous Information Filtering system [Ambrosini et al., 1997a-b]. The reader is referred to [Micarelli et al., 1998] for more details concerning the case-based inference mechanisms used in this component. In the User Model, the following items are gathered:

- A *content vector*, i.e., an array of values that represents the information content suitable for the Vector Space model matching, as explained in [The Data Structures].

- A list of currently *active contexts*. Contexts are initialised all the same for every user with a non-zero value in her/his user model content vector, for each cluster having one or more non-null contexts. Then these contexts are copied in the User Model which evolves independently according to the single user history.

- A list of the currently *active stereotypes*.

- A set of *user keywords*, each one weighted with a value representing its actual importance for the user.

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4. The Information Filtering Component

The Information Filtering task has been a major research field since the last ten years and is constantly growing thanks to the huge development of the Internet. In the following we present the main data structures and the case-based approach used in that component.

4.1 Data Structures

Information Filtering systems need sophisticated data structures to deal effectively with such an ephemeral thing as user's interests may be. On the other hand Information Retrieval research has developed fairly complex around the classical but effective Vector Space model, abstracting from single keywords to cluster of keywords and other more and more abstract objects, in order to improve discriminating performance. Our system is based on such a vector space model variant. We now introduce the two major data structures used in the system.

4.1.1. The cluster vector

The Vector Space model [see Salton, 1983] has been kept as a basis thanks to its very well known reliability and room for improvement, as constantly reported in the literature. The elements the vector is made up with are sets of <term, context> pairs, with term a word and context an object whose purpose is to disambiguate possibly ambiguous terms using words before and after the word under study [see Croft & Xu, 1995; Xu & Croft, 1996; Xu, 1997]. For instance, the term "network" can assume different meanings depending on the context where it is used. A naive Information Filtering system could assume that a document about "neural networks" is relevant for a query on computer networks. The cluster vector has been built once for all during an initial phase of knowledge extraction from a corpus of documents on a particular domain. Also in this phase all the contexts have been conceptually created examining each repetition of the same term in the corpus and measuring the distance between their contexts: if it is greater than a threshold parameter, the two instances of the same term are thought to have different meaning, and their contexts kept separated, otherwise their contexts are merged in one.

To recap:

- A Context is an object that keeps trace of words used when referring to a particular instance of the ambiguous term in a text. Its use is motivated by the assumption that terms related to different meaning of a single word tend to occur together [see Furnas et al., 1987].

- A T-C pair is a pair of <term, context> used to disambiguate the term applying its context on the input document.

- A Cluster of T-C pairs is a set of such elements clustered together for synonymy. All the T--C pairs grouped together in a cluster are all the same for the system. This mechanism allows for simplification while the use of T-C pairs instead of simple terms gives higher precision to the clustering mechanism.

4.1.2. Document Representation

Every text document in input is firstly transformed by the External Retriever in a list of words obtained selecting only those which are not present in a list of useless words (also known as a *stop-list*). Then the words are matched against the term dictionary and pointers are obtained to words known to the system . Each term is disambiguated using the known contexts for that term. For instance, if the system has three different contexts associated with a single word, the disambiguation step produces three values, representing the degree of fitness of that word occurrence in the incoming text and the given context. In the last step each pair <term,context> from the input document contributes to its belonging cluster weight with the values calculates in the third step. At the end of the process, from the initial text document (e.g. in HTML format) we have an array of values, each one for a cluster of <term,context> pairs.

4.2. Case-Based Information Filtering

Figure 3 shows the approach we have used to the selection of the most suited documents according to the *information needs* of the user represented in her/his model. In [Fig. 3] the two main steps of the case-based reasoner have been put in evidence. They are:

- The Document Categorization (retrieval phase)

- The Score Refinement (adaptation phase)

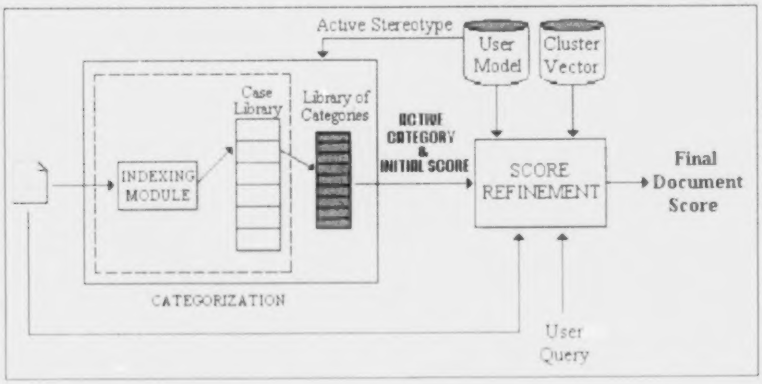

Figure 3: Case-Based Information Filtering

4.2.1. The Document Categorization

The case library contains the old cases (gathered from experts in the domain of computer science) in the form of frames, whose slots are the "document representation" and the "active category" (that can be viewed as a pointer to the Library of Categories). The categorization module takes as input the same type of weights vector of the filtering module, but with different clusters, because it needs to match different features like authors, type of documents, etc. in the incoming document. When the system is presented with a pattern of attributes relative to the particular document, the indexing module tries to find the old case that more closely matches (according to a specific metric) the new case. The selected old case contains the relevant information useful for classifying the document, i.e. the most suited category (or categories). To map the array of values - one for each category - coming as the categorization module output into stereotypes, a matrix "categories X stereotypes" (called CS-Matrix) is used, with each element representing an importance weight for that category in the given stereotype present in the User Model. Crossing the matrix columns of the currently active stereotypes with the categorization module output and summing the outcoming values we have the categorization contribution to the filtering score. The approach just described entails the definition of a metric to be used in the indexing module. The problem is that this sort of classification must often be made in presence of incomplete and contradictory information. Our proposed solution, similar to a framework which has already been experimented in the field of adaptive hypermedia [Micarelli & Sciarrone, 1996] and of User Modeling [Micarelli et al., 1998], consists in the use a function-replacing hybrid [Fu, 1994], where an artificial neural network implements (i.e., is functionally equivalent to) the indexing functionality of the case-based reasoner. The old cases present in the library of cases have been gathered from a domain expert, and have been used as training records for training the network. The knowledge of the Case Library is therefore represented in a monolithic way into the weights of the network. As a result, the metric of the indexing module of the case-based reasoner has been replaced by the "generalisation" [Haykin, 1994] capability of the network.

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4.2.2. The Score Refinement

The mechanism for the score refinement is described in [Fig. 4], being the first step the document transformation in a content vector:
- For the current document the categorisation module returns a score based on its output and the list of active stereotypes present in the user model.

- Only if the first stage returns a score higher than a given threshold the second step takes place. Three different modules process the document (represented differently for each module) returning three scores that combined linearly with given weights make up the final score.

The three different modules work independently each one performing the filtering based on a different perspective (Each module sharing a common mechanism for weighting words with their actual importance in the document; for instance, words appearing in the title in a HTML page are considered more important than words in a paragraph):

- The vector filter module transforms the document in an array of values that maps on the Clusters array as described in [The data Structures].This kind of filtering is performed using the standard techniques of the Information Retrieval field.

- The query module uses a list of words representation of the document and essentially counts the occurrences of the terms in the user query.

- The user keywords module matches each document word against a list of weighted keywords in the User Model producing the total normalised sum of each occurring word's weight.

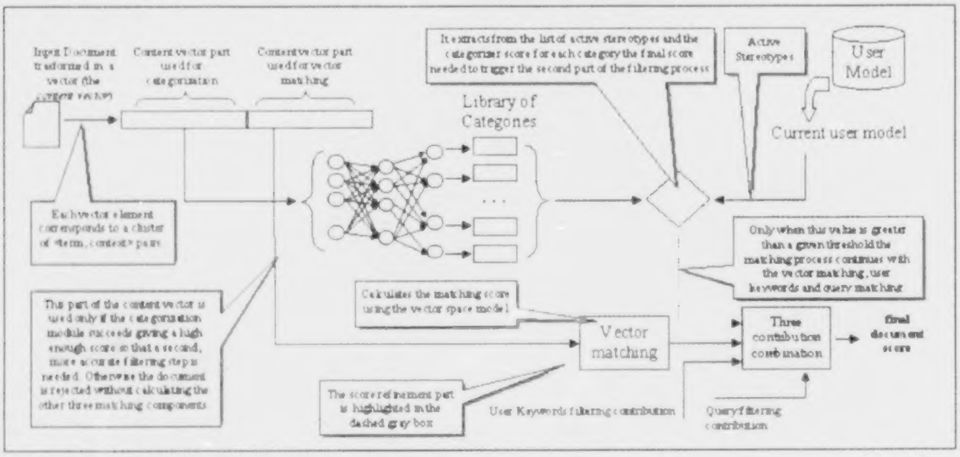
Input Document trasformed in a vector (the content vector)
Content vector part used for categorization
Content vector part used for vector matching
It extracts from the list of active stereotypes and the categorizer score for each category the final score needed to trigger the second part of the filtering process
Active Stereotypes
User Model
Library of Categories
Current user model
Each vector element corresponds to a cluster of <term, context> pairs
Only when this value is greater than a given threshold the matching process continues with the vector matching, user keywords and query matching
Calculates the matching score using the vector space model
This part of the content vector is used only if the categorization module succeeds giving a high enough score so that a second, more accurate filtering step is needed. Otherwise the document is rejected without calculating the other three matching components
Vector matching
Three contribution combination
final document score
The score refinement part is highlighted in the dashed gray box
User Keywords filtering contribution
Query filtering contribution

Figure 4: The Document Evaluation Process

Conclusions

In this paper we have described an Information Filtering system that uses a Case-Based approach. Such a system is able to select and to order HTML/text documents, collected from the Web, according to the "information needs" of the user, represented in a User Model. Our system is based on a hybrid architecture, where an artificial neural network is integrated into a case-based reasoner. One advantage of this architecture is the inherent fault tolerance to noise in data representing user behaviour, which allows the system to "gracefully degrade". In our work, we have turned to statistics to analyse the system behaviour, and demonstrated that the system performance "is not due to chance". A more extensive test of the system has been planned as a future work. We have also planned to develop and evaluate further features with the goal of improving the performance of both modeling and filtering processes. As for the modeling process, we are improving the modeling capabilities of the

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users by using a dynamic updating process of the user model. As far as the filtering process is concerned, we are integrating the query modality with the surfing modality to obtain a system able to autonomously retrieve and filter documents. The first experimental results we have obtained using the Wilcoxon test [Wilcoxon, 1947] are encouraging and support the choice of the Case-Based approach to Information Filtering.

References

Ambrosini, L., Cirillo, V. and Micarelli, A. (1997a). A Hybrid Architecture for User-Adapted Information Filtering on the World Wide Web. *The 6th International Conference on User Modeling UM-97*, Chia Laguna, Sardinia, Italy, June.

Ambrosini, L., Cirillo, V. and Micarelli, A. (1997b). A User-Adapted Interface for a Search Engine on the World Wide Web. *WebNet 97* - World Conference of the WWW, Internet and Intranet, Montreal, Canada, November.

Belkin, N.J., and Croft, W.B. (1992). Information Filtering and Information Retrieval: Two sides of the Same Coin?. *Communications of the ACM*, 35 (12), 1992, pp. 29-38.

Cohen, P.R. (1995). *Empirical Methods for Artificial Intelligence*. MIT Press, Cambridge, Massachusetts, 1995.

Croft, W.B. and Xu, J. (1995). Corpus-specific stemming using word from co-occurence. *The Fourth Annual Symposium on Document Analysis Information Retrieval*, Las Vegas, Nevada, April 1995, pp. 147-159.

Devore, J.L. (1995). *Probability and Statistics for Engineering and the Sciences*. Brooks/Cole Publishing Company, Monterey, California, fourth edition, 1995.

Fu, L.M. (1994). *Neural Networks in Computer Intelligence*. McGraw-Hill, 1994.

Furnas, G.W., Landauer, T.K., Gomez, L.M. and Dumais, S.T. (1987). The Vocabulary Problem in Human-System Communication. *Communications of the ACM*, 30 (11), 1987, pp. 964-971.

Haykin, S. (1994). *Neural Networks - A Comprehensive Foundation*. Prentice Hall International, 1994.

Micarelli, A. and Sciarrone, F. (1996). A Case-Based System for Adaptive Hypermedia Navigation. In I. Smith and B. Faltings (eds.) "Advances in Case-Based Reasoning, Proc. of EWCBR-96", *Lecture Notes in Artificial Intelligence*, 1168, Springer-Verlag, Berlin, 1996, pp. 266-279.

Micarelli, A., Sciarrone, F., Ambrosini, L. and Cirillo, V. (1998). A Case-Based Approach to User Modeling. In: B. Smyth and P. Cunningham (eds.) "Advances in Case-Based Reasoning, Proc. of EWCBR-98", Lecture Notes in Artificial Intelligence, 1488, Springer-Verlag, Berlin, pp. 310-321.

Morita, M. and Shinoda, Y. (1996). Information Filtering Based on User Behaviour Analysis and Best Match Text Retrieval. *Japan Advanced Inst. of Science and Technology Technical Report*, 15 Asahi-dai, Tatsunokuchi, Ishikawa 923-12 Japan.

Salton, G. and McGill, M.J. (1983). *Introduction to Modern Information Retrieval*. McGraw-Hill Publishing Company, NewYork, NY.

Xu, J. (1997). Solving the Word Mismatch Problem Through Automatic Text Analysis. *PhD Dissertation*, Dept. of Computer Science, University of Massachusetts, Amherst, May.

Xu, J. and Croft, B. (1996). Query Expansion Using Local and Global Document Analysis. *The Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, August, pp. 4-11.

Wilcoxon, F. (1947). Probability Tables for Individual Comparisons by Ranking Methods. *Biometrics*, 3, pp. 119-122.

Virtual Laboratory for Image Processing

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Abstract: The concept of Remote Education has captured considerable attention of educational organizations and the public. World wide expansion of Internet and its promulgation into every corner of our daily lives will bring a tremendous impact to the education. It will bring affordable education on every scholastic level into most areas of the world. Most education institutions in advanced countries either already offer or are experimenting with virtual classrooms. However, one area of Remote Education tat has been neglected so far is the area of laboratories.

In this paper we address that issue and present a virtual laboratory for computer graphics and image processing. The laboratory can be used by individual users working on particular topics or by groups of users as peers or under the supervision of instructors. It was designed to be part of our Remote Education Platform for education in computer science.

1. Introduction

With Internet removing the distance barriers Remote Education is becoming a very important function (feature) in our society [1]. We believe that the Internet will bring important changes in the education by making it more affordable, more accessible and considerably better quality. Many educational facilities already offer virtual classrooms, education material and discussion rooms over Internet [3 through 8]. However, the issue of virtual laboratories has not been addressed yet.

In this paper we address that issue and introduce a virtual laboratory for computer graphics and image processing. The laboratory can be used concurrently by any number of students that can be anywhere in the world, provided they have access to Internet. The laboratory can be used asynchronously by individual users exploring a particular topic or an image processing technique, or synchronously by groups of users as peers or under the supervision of instructors. It is completely computer platform independent. It has been incorporated into our Remote Education Platform [8], and it can also be integrated into any other application.

2. The Organization Of The Laboratory

2.1. Working Sessions

The virtual laboratory space is organized into sessions. The system can support any number of simultaneous sessions. A session may contain a single member, or it may be a group session containing any number of world-wide distributed users. A user may start a new session or join a session in progress. A group session may be "unstructured" in which participants work as peers that together experiment with certain ideas and techniques to enhance or manipulate images. Alternatively, a session may be "structured" in which the participants are guided by an instructor who presents a topic and demonstrates the concepts by systematically applying various techniques supported by the system. The participants in a session can communicate with each other through chat windows. In the future we plan to add voice communication channels.

Each session owns a group of objects participating in the session. These objects are the users participating in the session and all artifacts that the participants have loaded or created during the session. The artifacts may be images, drawings, text of communication messages between the session participants, and text annotations of individual images. The session objects may be interconnected through relationship linkages, e.g. all artifacts loaded or created by a participant are linked to that participant; the annotations of an image are linked to that image, etc.

Each object consists of two parts:

- ☐ a data structure that holds information representing the object, e.g. the data structure for an image contains the pixmap encoding the image, and
- ☐ a set of methods that are used to access, manipulate and display the representation of the object. Furthermore, it contains a definition of a graphical user interface that enables a user to manipulate and display the object.

2.2. Session, Server and Clients

Functionally, the laboratory comprises one server and any number of clients; one client per user. Sessions are supported by the server. At any point of time the state of each session is maintained by the server, i.e. the server contains the information about all participants and the representation of all artifacts of the session. Any request by a user that affect an object within a session is sent to the server. The server performs the desired operation and updates the state of the session, e.g. a change in an image. The representation of the new state for the session is then sent to all clients corresponding to the participants in the session.

A session can be saved for a recall at a later time. The save operation will store all artifacts belonging to the session, as well as the identity of session participants. The artifacts from the session can be also stored individually. They can be saved by a user either at the server supporting the session or locally on the computer used by that user to access the laboratory.

3. The Functionality Of The Laboratory

The laboratory provides the full functionality for image processing and object recognition and some functionality for 2D graphics. It supports simultaneous display and manipulation on any number of loaded images. The operations provided by the laboratory are grouped into the following sections:

3.1. Image Handling

The operations in this section are used to load, store, scale, rotate, flip clip and convert images.

3.2. 2D Drawing

The operations in this section are used to draw 2D figures, e.g. straight lines, circles, splines, 3rd degree curves, etc. Users can draw on blank canvases or over images or already existing drawings. When drawings are made over already existing drawings or images, they are rendered as overlays. The overlay drawings can be either stored separately or together with the images. This feature makes this system a very useful tool for making engineering drawings for utilities and traffic infrastructures. Users can draw over city and county maps and design roads, utility networks and then store such designs either separately or merged with maps.

3.3. Image Processing

This section contains image enhancement and processing operations. The operations include:

- Image Averaging to remove noise spikes
- Noise Removal
- Image Sharpening
- Reduction of colors in images

- Conversion of color images to black and white or gray scale
- Adjustment of color saturation (0 - 200%).
- Display of histogram as well as histogram equalization and specification.
- Detect edges in images

3.4. Object Recognition

This section contains procedures used to perform analysis of images and recognition of patterns and objects in images. These procedures include:

- Object Separation Through Thresholding - This function separates objects from the background within an image by partition of the gray scale histogram of the image according to single or multiple thresholds.
- Region Growing by Pixel Aggregation - This function collects pixels within an image into larger regions that become candidates for individual objects. It starts from a set of seed pixels that are automatically generated or selected by the user. The result is a set of regions of neighboring (connected) pixels that have similar properties, e.g. the difference between their gray scale values is smaller than a predefined threshold.
- Region Splitting and Growing - This function identifies regions within an image, by first subdividing the image into arbitrary disjoint regions and then merging those regions that have same attributes into larger areas.
- Patter Matching by Correlation - The goal of this method is to identify an object (i.e. image) within another larger image by using the correlation between these two images.
- Pattern Matching Within Frequency Domain Using FFT - This approach is often more efficient than the previous method, i.e. Patter Matching by Correlation. This is especially the case for larger objects (sub-images).
- Hough Transform - This method is used to identify figures within an image. This method is tolerant of gaps in the figures and is relatively unaffected by the noise within the image.

4. Implementation

We implemented the laboratory in Java version 1.1.5. We did consider C++ but settled on Java as it offered a number of distinct advantages:

☐ Platform independence in supporting graphics and graphical user interface

Using C++ one has to deal with two very different graphical platforms, Visual C++ on PCs and MOTIF/X-windows on Unix workstations. Java offers graphical platform independence on the source as well as on the run-time levels.

☐ User interaction

Java allow us to relieve the server of all operations that affect only the local user and can be performed on a client machine instead on the server using CGI scripts. This allows quicker responses to certain actions, since not every user action has to be transferred to the server.

☐ Object serialization:

Java provides the two special streams ObjectInputStream and ObjectOutputStream that work like regular input and output streams. However, they are special in that they can read and write whole objects. We don't have to worry about the internal representation of data. That is particularly relevant as the application is used on different platforms, which run on different architectures

Of course, there are also disadvantages:

- ☐ Execution speed
- ☐ Short live time of Java versions

Conclusion

In this paper we presented a world-wide distributed virtual laboratory for image processing. The application has been tested within realm of local area networks as well as over long distance networks. The implemented concept of replicated distributed objects works stable and is reliable. Although the application was mainly designed to support remote education and distributed group studies and discussion on images, the large number of image processing functions makes the application also suitable for stand alone image processing platform.

The system was also designed to be easily extendable for other types of multimedia objects. The basic concept of the system should therefore be also usable for other distributed education platforms that are not necessarily dealing with images and image processing. In fact the plans are to expand the laboratory to include 3D modeling and rendering.

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References

1. Hairston, D., Ed. (1998). *Remote Education*, Chemical Engineering, April 1998.
2. Meleis, H., (1996) *Toward the Information Network*, IEEE Computer, Oct. 1996.
3. Kouzse, R.T. & J.D. Myers, J.D., (1996). *Collaboratories: Doing Science on the Internet*, IEEE Computer, Aug. 1996.
4. Lee, K-C., et al (1997). *Design and Implementation of Important Applications in a Java-based Multimedia Digital Classroom*, IEEE Transactions on Consumer Electronics, v. 43, Aug. 1997.
5. Yu, S-S., et al (1997).*Application Sharing Framework on Java*, Proc. IEEE Intl. Conf. on Consumert Electronics, Chicago, June 1997.
6. Manohar, R., & Prakash, A., (1994). *Replay by Re-Execution: A Paradigm for Asynchronous Collaboration via Record and Replay of Interactive Multimedia Sessions*, ACM SIGOIS Bulletin, Vol. 15, No. 2, Dec. 1994.
7. Chang, I-C., et al (1997). *Design and Implementation of a Multimedia WWW-Based Note-Taking System for Distance Learning*, Proc. of Intl. Conf. on Consumer Electronics, Chicago, June 1997.
8. Marovac, N., (1998). *Remote Education System for Image Processing*, Tech. Report, Laboratory for Multimedia and Software Engineering, San Diego State University, 1998.

Successful Learning in the New Millennium: A New Web Learning Paradigm

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Abstract: This paper addresses the question of how to use Web technology to learn smarter, manage change better, continually improve learning, and offer more productive performance solutions. Offering a unique perspective about learning in the 21st century, this paper introduces (a) learner-difference profiles explaining individual learning differences, (b) reasons why some learners are more successful than others, and (c) strategies for helping learners improve Web learning ability. These insights offer simple ways to enhance and evaluate contemporary Web instructional designs so that they instill the right habits for continuous learning and performance improvement.

1.

1.Introduction

This paper is aimed at an audience wanting a new perspective on investigating and managing the impact of individual learning differences. The purpose is to offer explanations about the higher-order psychological influences on Web learning, describe when and why some learn more successfully than others, and offer practical design guidance that contributes to successful Web learning and performance. By the end of the paper, participants should have examined their own position on (a) the influence of key psychological factors (conative, affective, cognitive, and social learner-difference variables) that greatly influence Web learning, (b) recognizing critical links between Web learning environments, learning differences, and learning performance, and (c) developing supportive Web learning environments that match individual learning differences.

2.Background

For many years Russell [97] has been conducting comprehensive comparative research on using technology for distance education. After reviewing data from 355 research studies to examine what works or does not work, Russell [97, p. 1] states that research results are largely ambiguous and that "individual differences in learning dictate that technology will facilitate learning for some, but will probably inhibit learning for others, while the remainder experience no significant difference." He adds that "when lumping all the students together into a fictional 'mass' those who benefit from the technology are balanced by a like number who suffer; when combined with the 'no-significant-difference' majority, the conglomerate yields the widely reported 'no-significant-difference' results." In conclusion, Russell [97] advises that the "real challenge facing educators today is identifying the student characteristics and matching them with the appropriate technologies." Reeves [93] echoed parallel sentiments as he advocated the inclusion of stronger, more reliable theoretical foundations that explain fundamental learning differences. Similarly after his review of educational research, Bangert-Drowns and Rudner [91] concluded that no one knows what really works.

The confusing or inconsistent results arising from the research literature clearly indicates something critical is missing from our cognitive-rich learning constructs and contemporary educational technology theories. Snow and Farr [87, p. 1] suggested that sound learning theories are missing and realistically require a whole person view that integrates cognitive, conative, and affective aspects." These researchers advised that educators cannot ignore or overlook these key psychological aspects because they interact in important, complex ways to support learning and performance outcomes. Otherwise, explanations about learning differences will be ambiguous and *isolated* from reality [Snow & Farr, 87].

3.Intentional Learning Theory

What theories and models can help us analyze and differentiate the audience and accommodate individual learning needs for successful Web learning? Successful "whole-person" learning paradigms need to acknowledge that individuals are feeling, intentional, thinking, and social human beings. Hence, the new Web learning paradigms need to (a) recognize diverse, fundamental sources for human response, (b) differentiate the audience using higher-order psychological explanations for learning differences, and (c) offer strategies and methodology that identifies, measures, matches, and manages the impact of primary learner-difference variables.

This paper describes learning differences using *learning orientations* (learner-difference profiles) to differentiate the audience, plan "mass customized" strategies that achieve objectives and improve learning ability, and guide design of the instruction and environment. The theoretical foundation for learning orientations is the *intentional learning theory*. This theory describes higher-order psychological attributes and learner-difference variables for successful learning. It also introduces a conative-affective-cognitive-social learning model that highlights the dominance of emotions and intentions on learning. This view is in contrast to cognitive frameworks that overlook or minimize the important impact and guiding influence of conative and affective factors.

In other fields, researchers [Ledoux, 96; Goleman, 95] demonstrate that emotions and passions influence, guide, and, at times, override thinking (cognitive) processes. Child development researchers, such as Woodward [98], also describe how humans are highly goal oriented and use intentions to guide learning as early as age six months. Recognizing the power of emotions and intentions is also an important lesson for educators. Educators who can knowingly tap into a learner's emotions and intentions have a powerful advantage. The intentional learning theory recognizes that how successfully we support learning depends on how well we support individual needs with customized solutions that foster increasingly successful learning and performance. "This transition from *one-size-fits-all* to *mass customization* is already happening. It is apparent in the growing use of templates and learning objects for multimedia" [Martinez, 99a].

To describe or represent learning orientations, there are four profiles: *intentional, performing, conforming*, and *resistant*. These profiles (Tab. 1) represent an individual's general approach to learning—intentions, committed learning effort, and learning autonomy. The learning orientations represent how individuals, with (to some degree) varying beliefs, emotions, intentionality, and ability, plan and set goals, commit and expend effort, and then autonomously experience learning to attain goals.

Orientation	Conative/Affective Aspects	Committed Learning Effort	Learning Autonomy
INTENTIONAL LEARNER (Transformance)	Focus strong passions and intentions on learning. Be an assertive, expert, highly self-motivated learner. Use learning to transform to high, personal standards.	Set and accomplish personal short- and long-term challenging goals that may not align with goals set by others; maximize effort to reach personal goals. Commit great effort to discover, elaborate, and build new knowledge and meaning.	Assume learning responsibility and self-manage goals, learning, progress, and outcomes. Experience frustration if restricted or given little learning autonomy.
PERFORMING LEARNER (Performance)	Focus emotions/ intentions on learning selectively or situationally. Be a self-motivated learner when the content appeals. Use learning to perform to above-average group standards.	Set and achieve short-term, task-oriented goals that meet average-to-high standards; situationally minimize efforts and standards to reach assigned or negotiated standards. Selectively commit measured effort to assimilate and use relevant knowledge and meaning.	Will situationally assume learning responsibility in areas of interest but willingly give up control in areas of less interest. Prefer continual coaching and interaction for achieving goals.
CONFORMING LEARNER (Conformance)	Focus intentions and emotions cautiously and routinely as directed. Be a modestly effective, extrinsically motivated learner. Use learning to conform to easily achieved group standards.	Follow and try to accomplish simplistic task-oriented goals assigned by others – try to please and conform; maximize efforts in supportive environments with safe standards. Commit careful, measured effort to accept and reproduce knowledge to meet external requirements.	Assume little responsibility, manage learning as little as possible, be compliant, want continual guidance, and expect reinforcement for achieving short-term goals.
RESISTANT LEARNER (Resistance)	Focus on not cooperating. Be an actively or passively resistant learner. Avoid using learning to achieve academic goals assigned by others.	Consider lower standards, fewer academic goals, conflicting personal goals, or no goals; maximize or minimize efforts to resist assigned or expected goals either assertively or passively. Chronically avoid learning (apathetic, frustrated, discouraged, or disobedient).	Assume responsibility for not meeting goals set by others, and set personal goals that avoid meeting formal learning requirements or expectations.
	Situational Performance or Resistance: Learners may situationally improve, perform, or resist in reaction to positive or negative learning conditions or situations		

Table 1 Learning Orientations Profiles

4.New 21st Century Learning Paradigms

In response to Russell's [97] challenge to match technology to individual differences, the authors suggest that educators need to develop learning paradigms based upon an understanding of (a) how individuals intentionally learn differently and (b) how educators can use technology to match and support the differences in learning and improve learning ability. The new paradigms should add the more dominant conative and affective factors to the traditional highly cognitive paradigms and specifically consider a learning audience with differing passions, emotions, need for structure, and willingness to set goals, plan and apply effort and manage, interact, and collaborate in Web learning environments. This unique approach to audience analysis and instructional design is in contrast to traditional perspectives that highlight cognitive processes as the universal learner-difference variable.

5.Developing Web Design Principles

Which Web design principles can accommodate learners in order to fulfil their learning objectives? A previous research study [Martinez, 99b], which investigated using learning orientations to differentiate the audience and guide analysis and design of instruction and environment, demonstrated that a learner experiences greater positive effects to the extent that the instruction and environment can appropriately match, support, and improve the individual's learning orientation. The study results also provided evidence on specific factors that impact learning differences and contributed guidelines for customizing solutions for Web learning.

As we leave the classroom, eliminate full-time instructors, and move to Web learning environments, recognizing how to match individual learning difference is becoming increasingly important. "To be effective, Web instruction and environments should emulate the instructor's experienced, intuitive ability to recognize and respond to how individual's learn differently" [Martinez, 99a]. The learning differences described in Table 2 (organized by three learning orientations) are intended as general guidance for designing Web learning environments and instruction. These descriptions consider key issues that influence Web learning and provide specific information for accommodating the differences. Their overall purpose is to match the orientation to foster self-motivation, interest, interaction and more successful, independent learning. These same descriptions are also useful for creating a set of criteria against which Web instruction may be evaluated.

Learning Issues	Intentional Learners	Performing Learners	Conforming Learners
General Environment	Prefer loosely structured, mentoring environments that promote challenging goals.	Prefer semi-complex, semi-structured, coaching environments that stimulate personal value and provide creative interaction.	Prefer simple, safe, structured environments that help learners achieve easy learning goals in a linear fashion.

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	discovery, and self-managed learning.		
Goal-Setting and Standards	Set and accomplish personal short- and long-term challenging goals that may not align with goals set by others; maximize effort to reach personal goals	Set and achieve short-term, task-oriented goals that meet average-to-high standards; situationally minimize efforts and standards to reach assigned or negotiated standards.	Follow and try to accomplish simple, task-oriented goals assigned by others – try to please and conform; maximize efforts in supportive environments with safe standards
Learner Autonomy and Responsibility	Self-motivated to assume learning responsibility and self-direct goals, learning, progress, and outcomes. Experience frustration if restricted or given little learning autonomy	Situationally self-motivated to assume learning responsibility in areas of interest. Will willingly give up control and extend less effort for topics of less interest or in restrictive environments.	Cautiously motivated to assume little responsibility, self-direct learning as little as possible, and like to be more compliant
Knowledge Building	Commit great effort to discover, elaborate, and build new knowledge and meaning	Selectively commit measured effort to assimilate and use relevant knowledge and meaning	Commit careful, measured effort to accept and reproduce knowledge to meet external requirements
Problem Solving	Prefer case studies and complex, whole-to-part, problem solving opportunities.	Prefer competitive part-to-whole problem solving.	Prefer scaffolded support for simple problem solving.
User Interface	Open learning interface for high stimulation and processing capacity	Hands-on learning interface for medium stimulation and processing capacity	Consistent and simple interface for minimal stimulation and processing capacity
Presentation	Prefer occasional mentoring and interaction for achieving goals (MENTORING).	Prefer continual coaching and interaction for achieving goals (COACHING)	Prefer continual guidance and reinforcement for achieving short-term goals (GUIDING)
Feedback	Prefer inferential feedback.	Prefer concise feedback.	Prefer explicit feedback.
Motivational Feedback	Discovery	Interesting	Comfort
Group Interaction	Prefer open-ended, dynamic groups; balanced emphasis on social-emotional needs and high-standard task completion	Prefer semi-structured, purposeful groups; emphasis on task completion	Prefer well-structured and safe groups; emphasis on social-emotional needs
Group Collaboration	Learning-oriented; idea-seeking, encourages positive dissonance, emphasizes efficacy; numerous cycles of brainstorming, reflection, and self-critique; group prefers shared leadership; encourages intra- and inter-group interactions	Task-oriented; compromise-seeking; emphasizes efficiency; group prefers strong internal leadership; encourages intra-group interactions, avoids inter-group interactions	Completion-oriented; consensus-seeking; emphasizes compliance; group prefers strong external leadership; minimizes intra- and inter-group interactions
Learning Module Size	Short, to the point, summary linked to more detail if necessary	Medium, moderate explanations	Longer, detailed explanations, in a step wise approach
Examples	One good example and one bad example.	A few good and bad examples.	Multiple good and bad examples
Information Need	Holistic, specific information needed to solve a problem	General interests	To fill a requirement
Content Structuring	Prefer freedom to construct own content structure	Prefer a general instruction, limited ability to reorganize	Prefer to let others decide content structure
Sequencing Methods	Hypertext, sorting by meta-tags, precise access	Semi-linear, logical branching, access by subtopic	Linear, page-turner representations general access
Peer Interaction	High, belief that everyone can commit and contribute valuable insights	Moderate, easily frustrated by time required for peer interaction and superficial comments	Minimal, seldom values peer comments, wants answers from the instructor
Quality of Assignments	Usually far exceeds stated requirements	Fulfill requirements but do little more than that	Frequently don't meet the minimal requirements
Questioning Habits	Asks probing, in-depth questions about content	Asks questions to complete assignments, too busy taking notes	Asks mechanistic questions about assignments

Table 2 Learning Differences Described for Three Learning Orientations

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6.Conclusions

Hopefully, these suggestions will contribute to successful learning paradigms for the 21st century and a greater understanding about fundamental learning differences. When we design a course with only a universal type of learner in mind we unintentionally set learners up for frustration and possible failure. If we are serious about providing good instruction for learners, we must provide multiple ways to provide instruction and environments so that all learners have opportunities for success. These descriptions are a first step in recognizing and accomodating individual learning differences. They are also an important step in recognizing the expanded role and impact of emotions and intentions on learning, especially as online learners need to become more self-motivating and self-directing.

7.References

Bangert-Drowns, R., & Rudner, L. (1991). *Meta-analysis in educational research.* Paper presented to ERIC Clearinghouse on Tests, Measurement, and Evaluation, Washington, DC. (ERIC Document Reproduction Service No. ED339748)

Goleman, D. (1995). *Emotional* intelligence. New York: Bantam.

Ledoux, J. (1996). *Emotional brain: The mysterious underpinnings of emotional life.* New York: Simon & Schuster.

Maddux, C. (1993). Past and future stages in education computing research. In H. C. Waxman & G. W. Bright (Eds.), *Approaches to research on teacher education and technology.* (pp. 11-22). Charlottesville, VA: Association for the Advancement of Computing in Education.

Martinez, M. (1999a). Mass customization: A paradigm shift for the 21st century. *ASTD Technical Training Magazine*, July/August.

Martinez, M. (1999b). *An investigation into successful learning—Measuring the impact of learning orientation, a primary learner-difference variable, on learning.* Dissertation. (University Microfilms No. 992217).

Martinez, M. (1997). *Designing intentional learning environments.* Paper presented to the ACM SIGDOC 97 international conference on computer documentation, Salt Lake City, UT, 173-80.

Reeves, T. (1993). Pseudoscience in computer-based instruction. The case of learner control research. *Journal of Computer-Based Instruction*, 20(2), 39-46.

Russell, T. (1997). Technology wars: Winners and losers. *Educom Review*, 32(2), 44-46.

Snow, R., & Farr, M. (1987). Aptitude complexes. In R. Snow & M. Farr (Eds.), *Conative and affective process analysis* (Vol. 1). Hillsdale, NJ: Erlbaum Associates.

Sternberg, R. (1996). *Successful intelligence: how practical and creative intelligence determine success in life.* New York: Simon & Schuster.

A New Paradigm for Successful Learning on the Web

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Abstract: How do we support successful, lifelong learners and help them competently respond to rapidly changing opportunities in the 21st century. The answer lies in how well we understand the sources for successful learning and consider audiences differentiated by individual learning differences. After years of cognitive traditions, lack of *whole-person* theoretical foundations, and imperfect *one-size-fits-all* designs, today's paradigms are still overlooking the significant, higher-order impact of affective and conative influences on learning. The investigator introduced learning orientations (learner-difference profiles) to examine learning in different environments. This is a unique perspective that considers how conative and affective factors guide, manage, and sometimes override cognitive (thinking) processes. The ANOVA results show how learning orientation, time, and environments account for significant effects and interactions. These results demonstrate useful ways to analyze and differentiate the audience before designing solutions for more successful learning and performance.

1. Introduction

If the cardinal rule for instructional designers is to know thy audience then we need greater understanding of learning audiences, especially as we move from the classroom to Web learning. After years of cognitive traditions, a review of individual learning difference research (Martinez, 99b) stills shows a heavy focus on cognitive processes and information processing mechanisms. Today's cognitive-rich paradigms need a stronger infuse of conative and affective research for a more realistic view of successful learning. To ignore or subjugate the importance of a learner's intentions and emotions is to create fuzzy, *one-size-fits-all* solutions for audiences treated as global learners with homogeneous intentions and feelings about learning. In contrast, a more realistic, comprehensive understanding of learning differences considers the complex influences and relationships between conative, affective, cognitive, social, and other relevant factors.

For many years Russell (97) has been conducting comprehensive comparative research on using technology for distance education. After compiling data from 355 research studies to examine what works or does not work, Russell (97, p. 1) states that research results are largely ambiguous and that individual differences in learning dictate that technology will facilitate learning for some, but will probably inhibit learning for others, while the remainder experience no significant difference. He adds that when lumping all the students together into a fictional 'mass' those who benefit from the technology are balanced by a like number who suffer; when combined with the 'no-significant-difference' majority, the conglomerate yields the widely reported 'no-significant-difference' results. In conclusion, Russell (97) advises that the real challenge facing educators today is identifying the student characteristics and matching them with the appropriate technologies. Reeves (93) echoed parallel sentiments as he advocated the inclusion of stronger, more reliable theoretical foundations that explain individual learning differences. He suggested that much of the research in the field of computer-based instruction is pseudoscience because it fails to live up to the theoretical, definitional, methodological, and/or analytic demands of the paradigm upon which it is based, and it thus leads to ambiguous results. Similarly, after his review of educational research Bangerter-Downs and Rudner (91) concluded that no one knows what really works.

The confusing or inconsistent results arising from the research literature clearly indicates something critical is missing from our cognitive-rich learning constructs and educational technology theories. Snow and Farr (87, p. 1) suggested that sound learning theories are missing and realistically require a whole person view that integrates cognitive, conative, and affective aspects. The two researchers wrote that educators cannot ignore or overlook the key psychological aspects that interact in complex ways to support learning and performance outcomes. Otherwise, explanations about learning differences will be ambiguous and *isolated* from reality (Snow & Farr, 87).

2. Intentional Learning Theory

What theories and models can help us analyze and differentiate the audience and accommodate individual learning needs for successful Web learning? Clearly, successful learning paradigms need to acknowledge that individuals are feeling, intentional, thinking, and social human beings. Hence, the new Web learning paradigms need to (a) recognize diverse, fundamental sources for human response, (b) differentiate the audience using higher-order psychological explanations for learning differences, and (c) offer methodology that recognizes, explains, matches, and manages the impact of primary learner-difference variables. This study investigates individual differences by using *learning orientations* (unique learner-difference profiles) to differentiate the audience, guide design of the instruction and environment, and customize solutions that achieve objectives and improve learning ability. Learning orientations use the *intentional learning theory*, which describes higher-order psychological attributes and learner-difference variables for successful learning, as its theoretical foundation. There are four learning orientation categories: *intentional, performing, conforming*, and *resistant*. The learning orientations represent how individuals, with (to some degree) varying beliefs, emotions, intentionality, and ability, plan and set goals, commit and expend effort, and then autonomously experience learning to attain goals. This approach to audience analysis is possible because learning orientations encompass the higher-order, dominant influence of intentions and emotions. Researchers in other fields (Ledoux, 96; Goleman, 95) also show that emotions and passions influence, guide, and, at times, override thinking (cognitive) processes. Woodward (98), a child development researcher, also described how humans are highly goal oriented and use intentions to guide learning as early as age six months. Recognizing the power of emotions and intentions is also an important lesson for educators. Educators who can knowingly tap into a learner's emotions and intentions have a powerful advantage. This study recognizes that how successfully we support learning depends on how well we support individual needs with customized solutions that foster increasingly successful learning and performance. This transition from *one-size-fits-all* to *mass customization* is already happening. It is apparent in the growing use of templates and learning objects for multimedia (Martinez, 99a).

3. Study Purpose

The study purpose was to determine if learning orientation, time, and learning environment accounted for significant variance, effects, and interactions. For this study, the investigator developed a course, presented it in three Web learning environments, and provided adapted solutions for audiences differentiated by three learning orientations. After the analysis, significance levels would indicate how likely a result or relationship was true (that is, not due to chance). Significance would indicate the importance of analyzing learning audiences to identify learning orientations and match solutions to the major learning attributes for each learning orientation. Since individuals were not expected to learn alike, the investigator used learning orientations to hypothesize how individuals would learn more successfully in matched environments and less successfully in mismatched environments. Learning orientations helped to represent and examine human learning variability more realistically. This method for audience analysis is more discerning and robust than typical cognitive explanations (such as, learning styles and strategies) because it specifically highlights the dominant impact of emotions and intentions on cognitive and social processes. The investigator developed two research questions to examine the effects of learning orientations on the selected dependent research variables. (1) Do learners using intentional learning environments (Group EX1) benefit more than learners not using intentional learning environments (Control Groups CO1 and CO2)? (2) Do learning orientations influence group interactions?

4. Method

Before taking the *Discovering the Web* course, the learners took the Learning Orientation Questionnaire, which identified the individual's learning orientation, and were randomly assigned to a research group, that is, one of three Web learning environments, where they received different instructions (the intervention) for taking the course.

1. *Web Learning Environment 1* was the experimental group (Group EX1) and presented an intentional learning environment. It offered the treatment that matched and supported the three learning orientations and intentional learning performance. The instructions delivered the intervention, called Intentional Learning Training (ILT), at the beginning of the course to encourage intentional learning performance.
2. *Web Learning Environment 2* was the first control group (Group CO1) and presented the performing learning environment. It offered the Group EX1 instructional setting but omitted the special ILT intervention instruction.

3. *Web Learning Environment 3* was the second control group (Group CO2) and presented the conforming learning environment. It offered a menu-driven version, but not the intentional learning resources or the ILT intervention.

These Web learning environments were part of an instructional and research model called the System for Intentional Learning and Performance (SILPA). The assignment to an environment did not necessarily match the learner's learning orientation. Learners took the course on their own, stopping as necessary, until they completed the eight lessons and assessments. Learners typically took one and a half hours in one session to finish. 49 women and 22 men (mean age = 22) volunteered to take the Web course. All adult subjects had very limited or no Web experience. Most of the volunteers were undergraduate students from a local Western University. Other volunteers were from the general public, including white- and blue-collar employees in positions at all levels of business, corporate trainers, young and older housewives, university and high school faculty, retirees, and high school and university graduate students. Obtaining a broad sample was helpful in generalizing the results to the public. The course assessments were not adapted using learning orientations since preliminary research was needed to integrate conative and affective factors adequately. The investigator introduced the achievement variable to collect evidence showing how the learning orientations achieved in the three groups. In this study, achievement was not expected to show any statistical significance and was included as a basis for observation, data collection, and a beginning in the examination of how to develop instruction with assessments using a broader set of psychological factors.

4.1 Experimental Research Design

The investigator developed an experimental factorial research design and conducted multiple repeated measures univariate analyses of variance (ANOVA). This factorial design helped in the analysis of independent and interactive effects of two independent variables (learning orientation and intentional learning training) on four dependent variables (*satisfaction, learning efficacy, intentional learning performance*, and *achievement)*. Factorial designs are useful because researchers can examine *effects* more realistically by controlling and analyzing more than one variable simultaneously. A second advantage of the factorial approach is that you can control additional variables that you know will influence the analysis. To allow for the effects of time, the investigator used repeated measures to test subjects several times (three times in this study) for a measure of each independent variable. A third advantage of this design is that the factorial approach lets the researcher manipulate, control, and analyze *interactions*, in addition to *effects*. This research design is unique because it overlays learning orientation as a separate dimension to (a) guide design and development of the research environment, content, and presentation, and (b) differentiate the audience before introducing the treatment and examining the results. This step is especially important because it distinguishes learners as individuals with predominant psychological characteristics in comparison to traditional methods that may treat learners unrealistically as a global group with homogenous influences.

Treatment	Orientations	A_1	A_2	A_3
1 GROUP EX1 (with ILT & iCenter)	Cat. 1 - 3	Y Measures	Y Measures	Y Measures
2 GROUP CO1 (w/o ILT, with iCenter)	Cat. 1 - 3	Y Measures	Y Measures	Y Measures
3 GROUP CO2 (w/o ILT & iCenter)	Cat. 1 - 3	Y Measures	Y Measures	Y Measures

Note. The table shows three research groups with or without the Intentional Learning Training (independent variable 1) and *iCenter* resources: Group EX1 is the experimental group, and Groups CO1 and CO2 are the control groups. The three orientation categories appear as Cat. 1, Cat. 2, and Cat. 3 to differentiate the subjects within the three research groups by three learning orientations (independent variable 2): intentional, performing, and conforming learners, respectively. Resistant learners are not included. The repeated Y measures for the four dependent variables appear in columns A_1, A_2, and A_3.

Table 1: Repeated Measures Research Design

The repeated measures design resulted in four data sets: (1) pre-course registration and (2) three sets from the practice and assessment activities in the three time periods. To analyze the data, the investigator used an analytical model that would treat the time variable as repeated subintervals of the instructional cycle between and among the three research groups. According to Littel et al., repeated measures data need mixed models because of correlations between measurements on the same subject (Littell et al. 96). Following this advice, the investigator used a modified mixed model repeated measures

(PROC MIXED) example from Littell, Freund, and Spector (91) in the SAS system (with special parameters for learning orientation treated as a continuous subject variable).

5. Results

The study's evidence suggests that learning orientation is a rational and useful way to (a) provide theoretical foundations using a comprehensive view of learning, (b) recognize dominant psychological factors, other than just cognitive aspects, that influence learning (c) analyze and differentiate the audience an important aspect of determining what works for the audience, and (d) guide design, development, implementation, analysis, and evaluation of solutions and environments.

5.1 Multiple Repeated Measure ANOVA Results

Using *ILO* (learning orientation), *GROUP* (EX1, CO1, and CO2), and *TIME* (A_1, A_2, and A_3 for three instructional units) as variables, the ANOVA results exhibited significant main effects and interactions for three dependent variables

1. GROUP effects on satisfaction ($\underline{F} = 5.30$, $\underline{p} = .0074$) and learning efficacy ($\underline{F} = 6.64$, $\underline{p} = .0024$) at a significance level of .01 (99%)
2. ILO * GROUP interactions on satisfaction ($\underline{F} = 6.48$, $\underline{p} = .0027$) and learning efficacy ($\underline{F} = 3.93$, $\underline{p} = .0245$) at a significance level of .01 (99%) and .05 (95%), respectively
3. TIME effects on learning efficacy ($\underline{F} = 31.82$, $\underline{p} = .0001$) and intentional learning performance ($\underline{F} = 14.77$, $\underline{p} = .0001$) both at a significance level of .0001 (99.9%)

Significance levels exhibit whether there is a statistically significant difference between two means. Significance levels of .0001, .01, and 05 are the values commonly used to show statistical significance. In academic fields, a theory should have at least a 95% chance (.05 significance level) of being true. The first significance level, such as .01, means that the finding has a one percent (.01) chance of not being true, which is the converse of a 99% chance of being true. In contrast, the high significance level for TIME effects (.001) has a 99.9% chance of being true. Examining these results, the investigator concluded that GROUP, TIME and ILO * GROUP have significant effects and interactions on the sample population regarding satisfaction, learning efficacy, and learning performance. Specifically, these results suggested the importance of understanding GROUP and TIME effects and ILO * GROUP interactions as factors in supporting and improving learner attitudes, learning efficacy, and intentional learning performance. As expected, the ANOVA analyses (not shown) presented nonsignificant results for the achievement variable.

To supplement the ANOVA analyses, the investigator examined group means and standard deviations by time for the four dependent variables. These results show that Group EX1 had the highest overall group means for three of the four dependent variables. However, the overall group means for achievement are very similar between groups (Group EX1: $\underline{M} = .83$, Group CO1: $\underline{M} = .85$, and Group CO2: $\underline{M} = .84$). As expected, each group mean averaged out to the group's majority orientation (that is, performing learners for each group). Yet, if we look closely at the achievement results (organized in the groups by learning orientation), the findings show that each of the learning orientations performed highest in the group with their matching learning environment (Group EX1: $\underline{M} = 94\%$ for intentional learners, Group CO1: $\underline{M} = 91\%$ for performing learners, and Group CO2: $\underline{M} = 87\%$ for conforming learners).

5.2 Bivariate Plots by Learning Orientation

It was not possible to use ANOVA analyses to examine specific performance by learning orientation within the groups. However, the investigator used eight bivariate plots to exhibit how individuals, grouped by learning orientations, performed within the GROUP and by TIME. Using the SAS system's PROC REG and the unstandardized regression weights for the predicted intercept and slope by GROUP or TIME, the investigator plotted the regression lines between X and Y. One of the eight plot (shown in Figure 1) describes achievement by learning orientation within the three GROUPs. These results suggest that as learning orientation increased, the learners in Group EX1 exhibited the highest achievement and vice versa. In the other two learning environments the learner's achievement barely improved, regardless of the learning orientation. Interestingly, the slope of GROUP EX1 is steep enough (Figure 1) to suggest that refinements to the assessment models may contribute to significant effects and interactions in the future.

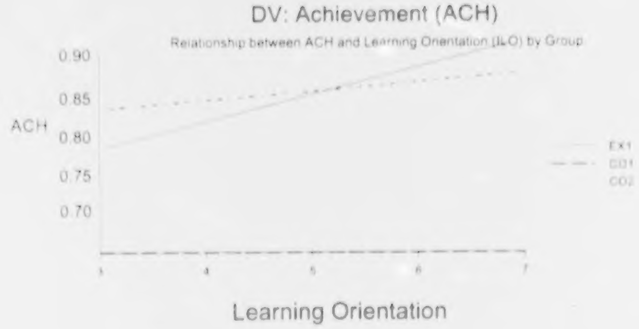

Figure 1. Linear Equations for Achievement (ACH) Showing the Regression of Y on X by Group

Research Question 1: Do learners using intentional learning environments (Group EX1) benefit more than learners not using intentional learning environments (Groups CO1 and CO2)? Group EX1 offered the learning environment with the highest group means for three dependent variables (satisfaction, intentional learning performance, and learning efficacy) and highest achievement means for intentional learners. As was previously mentioned, the achievement group means showed that individuals did best in the environments which best suited their learning orientation. The ANOVA results (Section 5.1) indicate the 99% probability that learning environments impacted learning satisfaction and efficacy. The group means showed that the learning environments impacted all the dependent variables. These findings suggest that learning environments influence learning outcomes depending on how successfully it matches and supports the learning orientation and individual learning differences.

Research Question 2: Do learning orientations influence group interactions? The ANOVA results (Section 5.1) indicate how interactions between learning orientation and environment seem to have impacted satisfaction (99%) and learning efficacy (95%). The evidence suggests that recognizing and being sensitive to the learning orientations is useful in guiding the design of instructional solutions and environments. Although learners achieved best in the environment which suited their learning orientation, it is important to consider that they were not in an environment that would help them experiment and improve intentional learning ability. The investigator will use these findings to focus development efforts on making the performing and conforming learning orientations more comfortable, engaged, and willing to perform in environments that subtly help them improve learning ability.

6. Conclusion and Contributions

This study investigates the importance of learning orientation and (a) using it to determine and explain key learner-difference variables, (b) integrating it into audience analysis and design methodologies to differentiate audiences and customize solutions, and (c) supporting it for more satisfying, successful learning and improved learning performance. These findings highlight how to support differentiated audiences with greater sophistication and specificity then primarily cognitive perspectives permit. Supporting the research hypothesis, the results indicate the need to provide (a) sophisticated, discovery learning situations for intentional learners when they want to be assertive, high-standard, high-effort learners, (b) non-risk, competitive, interactive settings that help performing learners overlook requirements for extra effort and difficult standards, and (c) scaffolded, structured, non-risk settings that help conforming learners learn safely and comfortably, then gradually help them internalize more intentional learning performance. The investigator hopes that these results revitalize the often-ignored, human perspective for differentiating audiences using conative and affective factors along with the more commonly explored cognitive and social learning factors. With practice, the matched solutions for differentiated audiences will be less expensive and offer better results because the individual assumes greater responsibility, sets and attains increasingly higher goals, expends greater, faster effort, and enjoys continually improving learning and performance. As a contribution to study of individual learning differences, this study

(1) Highlights the importance of considering a comprehensive set of affective, conative, cognitive, social, and other related learner-difference variables. (2) Demonstrates the need for sound theoretical foundations that incorporate the influence and relationship between higher-order psychological factors into measurable whole-person learning constructs. (3) Offers explanations on how some learners benefit from one type of solution and others do not. (4) Provides a Web learning

environment that can differentiate the audience by learning orientation, match individual and mass customized solutions, offer components that help learners internalize more intentional learning performance, and enhance use of learner-managed instructional treatments. (5) Offers analysis and design strategies for mass customization, that is, ones that identify and match differentiated-audience solutions to foster improved learning and performance.

7. REFERENCE

Bangert-Drowns, R., & Rudner, L. (1991). *Meta-analysis in educational research*. Paper presented to ERIC Clearinghouse on Tests, Measurement, and Evaluation, Washington, DC. (ERIC Document Service No. ED339748).

Goleman, D. *Emotional Intelligence: Why it can matter more than IQ*. New York: Bantam, 1995.

Ledoux, J. *The emotional brain: The mysterious underpinnings of emotional life*. NY: Touchstone Books, 1998.

Littell, R., Freund, R., & Spector, P. *SAS systems for linear models*, (3rd Ed.). North Carolina: SAS Institute, 1991.

Littell, R., Miliken, G., Stroup, W., & Wolfinger, R. *SAS systems for mixed models*. North Carolina: SAS Institute, 1996.

Martinez, M. (July/August 1999). *Mass customization: A paradigm shift for the 21st century*. ASTD Technical Training.

Martinez, M. *An investigation into successful learning: Measuring the impact of learning orientation, a primary learner-difference variable, on learning*. Dissertation. (University Microfilms No. 992217), 1999.

Martinez, M. *Designing intentional learning environments*. Paper presented to the ACM SIGDOC 1997 International Conference on Computer Documentation, Salt Lake City, UT, 173-80.

Reeves, T. 1993. Pseudoscience in computer-based instruction. The case of learner control research. *Journal of Computer-Based Instruction*, 20 no. 2:39-46.

Russell, T. (1997). Technology wars: Winners and losers. *Educom Review*, 32(2), (1997), 44-46.

Snow, R., & Farr, M. Cognitive-conative-affective processes in aptitude, learning, and instruction: An introduction. In R. Snow & M. Farr (Eds.), *Conative and affective process analysis* (Vol. 3, 1987, pp. 1-10). Hillsdale, NJ: Erlbaum.

Woodward, A. *Infants selectively encode the goal object of an actor's reach*. Cognition, 69, (1998), 1-34.

Appendix A

Learning Orientations

Intentional Learners Deeply influenced by an awareness of the passions and intentions that motivate them, intentional learners place great importance on personal strengths, intrinsic resources, ability, committed, persistent, assertive effort, sophisticated learning, performance, planning and problem-solving skills and strategies, and positive expectations to self-manage learning successfully. These learners manage holistic to partist strategies, short- and long-term goals, and enjoy using learning to acquire expertise; they will even risk making mistakes to attain greater expertise. Intentional learners enjoy taking responsibility and control of their learning and willingly become actively involved in self-managed learning. These individuals learn best in open or discovery environments that support expertise building; risk-taking; mentoring relationships; self-directed learning; complex, problem-solving or case study situations; and high learning standards.

Performing Learners Performing learners are low-risk, skilled learners that consciously and capably use strategies, preferences, and self-regulated learning skills to achieve average-standard learning objectives. Performing learners, in contrast to intentional learners, are short-term thinkers, task-oriented, and often extrinsically motivated. They take fewer risks with mistakes and difficult goals, focus on grades, rewards, and normative achievement standards, and often rely on coaching relationships, available external resources, and social influences to accomplish a task. Performing learners will selectively work hard to learn topics and skills that they highly value and find particularly interesting. Otherwise, they clearly acknowledge that they want to limit learning effort (e.g., they do not have enough time) by only meeting stated objectives or getting the grade. These learners learn best in semi-structured learning environments that add competition, fun, interaction, and coaching for self-motivation.

Conforming Learners Conforming learners are more complying and passively accept knowledge, store it, and reproduce it to conform; complete assigned tasks if they can, and please others. The conforming learner does not typically use initiative, think critically, like to make mistakes, reflect on progress, synthesize feedback, or give knowledge new meaning to change themselves or the environment. These learners are less skilled and have difficulty solving complex problems and accepting or managing change. They have little desire to control or manage their learning or set challenging personal learning goals.

Modeling Information to Support Value-Adding: EdNA Online

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Abstract: An historical and technical account of the development of EdNA Online, a website which serves the education and training community within Australia and focused on maximising the benefits of the Internet for education. The collaborative framework that is EdNA (Education Network Australia) is outlined with an emphasis upon the aggregation of value achieved through collaboration. Shortlisted for the 1998 Carl Bertelsmann prize, EdNA Online provides a range of services and functions – from a directory of information about all aspects of education and training in Australia, to quality content supporting resource discovery, to a facilitator of networking opportunities among its constituencies. A 'data model' is presented as an abstraction which attempts to synthesise the current foundations of the website while providing a tool for considering its ongoing development. Matching the pursuit of mutual benefit through collaboration with the data model reveals the commonality of 'value-adding'.

1. Introduction

Originally initiated in 1995 through a cooperative arrangement between the Ministers of Education and Training of the Australian Commonwealth, State and Territory governments – and at the time primarily as an infrastructure connectivity project – Education Network Australia (EdNA) has since consolidated as an ongoing national collaboration. It is focused on maximising the benefits of the Internet for education. As well as government interests, it brings together representatives from all the education sectors – schools, vocational education and training (VET), adult and community education (ACE), and higher education. In 1997 its most visible product of this collaborative activity, the EdNA Directory Service, was formally launched as a Website. At this stage, this website was clearly positioned to act as the foremost gateway for online educational information in Australia. The potential for resource discovery which promised a stamp of quality (through careful evaluation by educators) was seen as a tremendous value-add for all involved. In late 1998 the EdNA Directory Service was renamed [EdNA Online 1999] to reflect the fact that communications, interactive services, and networking were recognised to be equally as important for education as quality online information-based content.

While it is important that as an ongoing collaboration EdNA is understood to be much more than an information gateway – and much more than a website – this paper is focused on what stakeholders began to refer to in 1998 as a data model for EdNA Online. In this discussion, we concentrate on illustrating how value-adding emerged as an important process which not only guaranteed quality content but became identified as a strategic consideration and indeed a feature of the EdNA framework. The data model presented here is not intended to be a static picture, but rather a snapshot of an ongoing evolution.

2. System Overview

During the early stages of the EdNA project a Website (as a directory service) was established as an important central focus. It was thought that such a directory system would be best served through a browsing paradigm. At that time (1995) none of the current major search engines had achieved any widespread presence and the main global directory was the emerging *Yahoo!* which was predominantly accessed through user browsing. Technical advisers to the EdNA Task Force offered a few software solutions with Oracle being chosen, mainly because of its support for the dynamic generation of Web pages, a feature that was very much in its infancy at the time. A fundamental part of this process was the use of Oracle's PL/SQL to generate pages dynamically from information stored in a database.

The dynamic generation of Web pages was also very new at that stage and the possibilities seemed endless. Features such as personalised pages were trialled, with users being able to select different graphical themes and starting points in the category tree. These were supported through use of 'cookies', which, in Australia at least, suffered considerable misunderstanding and criticism from those concerned about privacy issues. Use of logins through user-IDs and passwords were considered to have greater privacy implications and in the end, the personalising features were dropped. With the current, and more sophisticated, implementations of 'profiles' in office-based software as well as on the Web this is now being re-visited for EdNA Olnine.

It was quickly recognised that the browsing facility needed to be complemented by a searching mechanism. There were several alternatives for this and a combination of the Verity Internet search engine with the Harvest freeware robot was selected. The robot was set up to gather full-text information based on the items that had been stored in the database. This information included directions for the robot as to how deep and how wide it should follow hyperlinks.

An index was also created from the information held for each item in the database. This provided a much more targeted searching capability and one which was guaranteed to return only quality information which had been evaluated and enriched with metadata by education experts.

Once the basic technical mechanisms were in place, there was a necessity to identify suitable Web resources and to build the content to a level that would be useful. At first this was done centrally but due to the widespread nature of the user and stakeholder base a concept of 'devolved (or distributed) administration' seemed to offer better leverage. There were, after all, potentially thousands of content identifiers. To do this it was necessary to provide a distributed administration system which included security control through user-IDs and passwords.

When this part of the system was developed in early 1996 there was nothing available commercially to support such a security system and so it was built into the system using the Oracle database and PL/SQL code. A system of security groups was developed and the 'state' was maintained through a code which was passed in successive URLs. This was made possible through the dynamic generation of each page which could include the appropriate code with each URL written into every page.

The distributed administration enabled the identification and inclusion of quality content to be built up to a reasonable level. This was supplemented by a form made available to users to suggest their own items for inclusion. Suggested items were stored in the database in a 'pending' state until they could be examined and either rejected or included for public access. An email address was also provided for feedback and suggestions which also assisted in building up the level of content.

Another feature included in the initial system was the hosting of Majordomo mailing lists. Registered users were able to utilise the administration system to set up and manage their own mailing lists via a forms interface. This was set up to buffer the user from the complexities of the normal mailing list administration and also to control the features that were allowable within the EdNA-hosted lists. Archival of these lists was provided as an option which was achieved through the EdNA system 'subscribing' to these lists and groups. The messages were stored and indexed for searching using the same Verity engine which was supporting the main searching facilities.

2.1 Current Implementation

These features have served EdNA well and the database of approved items has been built up to some 8,500 items. These items have spawned the full-text indexing of over 230,000 additional Web pages which can be accessed via the search facility.

Considerable work has been undertaken on the development of a comprehensive category tree which is used for browsing and allocation of items to parts of that tree. By and large, this process has been fairly disciplined resulting in a reliable, though not entirely engaging, method of resource discovery.

However, by mid 1998 the initial system architecture was showing its age. The increase in information held and the growing use of the service created additional strains. Like any large scale information technology development, this has made it increasingly more difficult to amend the system and to integrate new features.

Performance has been an issue which has largely been dealt with through increasing the power of the hardware. The mechanism of generating every page through PL/SQL code is now dated and is scheduled to be replaced so that the bulk of the processing is more closely aligned with the Web Server software rather than being executed within the database environment.

The freeware Harvest robot, used for gathering full-text searchable information, has not been supported for some time and has caused problems, probably due to the size and complexity of the tasks it was attempting to perform. The use of the Majordomo software for EdNA hosted mailing lists has also shown similar problems.

The original 'devolved administration' system has worked well, but it no longer provides the flexibility required due to the base of those who would administer particular parts of the system increasing significantly. One example of this is in the control of the mailing lists, where it is desirable for various levels of education participants (e.g., state bureaucracies, educational institutions, individual educators and even students) to be able to manage lists and possibly allocate list management rights to others.

The Noticeboard system implemented in 1997, based on NNTP, likewise hasn't provided the flexibility required in the management of notices or in the selection and presentation of notices to users.

Considerable effort has gone into the area of metadata usage as this is seen as one of the most important strategies for providing a quality and coherent set of resources that can be easily and usefully accessed by users. The 'Dublin Core' standard was chosen as a sound foundation from which to proceed.

The issues described above have now provided the opportunity to step back and examine the architecture and direction of EdNA Online and, in particular, to develop a data model which will provide a solid basis for its development and beneficial use into the future. The remainder of this paper describes the current thinking and implementation surrounding this evolving data model.

3. The Data Model (I)

Developed in 1998 the first draft of an EdNA Online data model identifies five types of information: documents; items; search indexes; categories; and, linkages. 'Documents' are Web-based resources of potential interest to users in the education community. 'Items' can be described as value-added containers which consist of all metadata that EdNA has associated with a particular document, regardless of the origin of that metadata. In this regard, EdNA has been an early adopter of Dublin Core metadata as a basis for its own standard which is implemented as a means for enriching its database of stored items (URLs enriched with metadata after evaluation). The main difference between these two information types is that documents are the raw resources that are created and maintained outside the EdNA environment (in fact anywhere on the Web) whereas items are the units on EdNA which contain the information about each document.

Searching functions of EdNA Online are, based on 'indexes' which contain detailed information about the text within each document. 'Categories' support the browse approach to information retrieval and enable navigation to useful material as an alternative to search. 'Linkage' is an architectural concept; an attempt to extend 'traditional' metadata concepts to include the relationship that documents have to additional, associated information such as review material or other documents. To date, this concept currently only has a very basic implementation. The higher education sector, in particular, sees a lot of benefit from developing this concept for providing greater flexibility and malleability into the data structures within the EdNA Online database.

These information types support the process of value-adding – an essential component of good customer service and in harmony with the value-adding brought about through collaboration

3.1 Documents

Documents have not typically been hosted by EdNA Online, although there is a move toward changing this. With its initial emphasis as a directory service and gateway, EdNA Online largely points to documents which reside on their original servers.

The issue of quality is addressed in a number of ways. With documents residing on other servers, and the Web with a characteristic disposition toward changeable content, the quality of a document is usually beyond EdNA's control. However, the overall co-ordinating body of EdNA – Education.Au Limited – enters into 'service agreements' with 'registered partners', or information providers, who in turn ensure certain quality standards are adhered to. Ultimate responsibility for the quality of a document lies, of course, with the information provider. Each sector has appointed project officers who attend to evaluating content for the service. Complementing this activity, Education.Au also engages in continued monitoring of the service as well as in a range of other activities such as maintaining overall coherence and currency of content. Such processes work to ensure that content accessed via EdNA Online is of a suitable standard.

3.2 Items

Items, the identifiers which refer to documents, are the metadata stored in the database. The bulk of items currently on EdNA Online have been input manually and are either collected by suggestions from the Website users or routinely sought out by project officers. However, there are many organisations within Australia which perform similar functions within their own localities and maintain similar information which is of interest to their particular constituents. These organisations have also been manually entering their identified items into the EdNA database, a process which has resulted in 'double handling' of the information. The potential efficiencies of an automated process have been recognised for some time and this has led to the implementation of a harvesting project, currently being tested.

Items currently have provision for holding content relating to all the 15 Dublin Core elements as well as a further nine EdNA-defined elements. Of these latter elements, the EDNA.Categories and EDNA.Indexing elements are of particular relevance to this paper. If an item contains EDNA.Categories metadata the document pointed to by the item becomes browsable 'core' item. EDNA.Indexing values are assigned by administrators as a depth guide for the EdNA robot indexer. These documents are full-text indexed and stored in a separate index to the core items. Items may identify more than one category, thereby linking the referenced document to relevant 'information zones'.

3.3 Categories

The browse directory on EdNA Online displays categories arranged as a tree structure. The linkages for this structure are held in a table in the database which is used to dynamically generate the pages which display each section of the tree as the user drills down. The category tree provides a comprehensive overview of Australian education and enables users to browse for 'core' or evaluated information.

Adding a category to an item requires a certain amount of education and training in itself and is non-trivial. Attaching categories to documents places the document in particular information zones. Familiarity with the category tree certainly assists in locating information quickly. However, at the time of writing, stakeholders are engaged in the process of examining different categories and their relationships with a view to de-coupling category functionality from the current interface constraints of a drill-down category tree .

3.4 Indexes

Indexes are used as the basis for the search facilities on EdNA Online. This task is currently performed by the Netscape Compass Server which, based on the EDNA.Indexing metadata field, gathers text and metadata from pages referenced by core items and creates a search index which is in a format that can be accessed by the

Verity search engine. There are currently two main indexes used to return the results to queries made through the search options: the full-text index for non-core items and an index for the title, keywords, and descriptions of the browsable core-items. The first is maintained through the Compass Server robot process and the second is built through a Verity gateway to the information held in the Oracle database. While this dual approach of maintaining two indexes was important in developing the Website, development work initiated in late 1998 aimed at merging the two indexes in a process which has brought search and browse into closer alignment.

3.5 Linkage

Linkages are currently implemented only through the existing constraints of the item table in the database where categories are assigned. However, beyond such obvious architectural structure, the EDNA.Review element (designed to store reviews of documents provided by third parties) also relates closely to this concept. Annotations also operate as a linkage to a document. The current implementation in the form of metadata elements is limited by a uni-directional information flow. The authors believe, however, that there is potential for a new mechanism which provides a bi-directional linkages. While this may be difficult to implement it may also break new ground in enhancing a model for collaboration and community building in education.

4. The Data Model (2)

Further refinement of the model presented above has now led to another abstraction which classifies all data types into three. In this abstraction these types are named Types 1, 2, and 3 respectively.

4.1 Type 1 Data

Resources that end users are interested in and often referred to as 'content' can be described as Type 1 data. Such resources may include Web pages, software, or dynamic data (such as current stock values or the weather). In the first model, 'documents' describe Type 1 data. However, if an end user is specifically interested in Type 2 and Type 3 data then in a way their interest determines that the data they seek also has some Type 1 status.

4.2 Type 2 Data

Type 2 data is defined as data which is derived directly from Type 1 data in order to conserve computation or cognitive load in performing some function on Type 1 data. For EdNA Online, the 'items', 'categories' and 'indexes' are Type 2 data, as is metadata (information about data). These are data derived from Type 1 data (harvested metadata, or created by the search engine as an index). In other terminology, Type 2 data can be seen as an 'asset' of search sites (such as *Yahoo!* or *Alta Vista*).

4.3 Type 3 Data

Type 3 data is defined as data that describes relationship(s) between data and therefore cannot be derived from Type 1 data alone. It relates to 'linkages' described in the first model. Examples of Type 3 data include: the data that describes the hyperlinks between documents; the grouping relationships between data (the EdNA category tree is itself Type 3 data although the metadata element 'EDNA.Categories' in each resource is not); the usage logs of a proxy server about Web pages; or, the popularity rating of a Web page among similar pages. Clearly, a single datum of Type 3 is fairly useless – just like a telephone, if only one existed it would be useless. The power of Type 3 data is the collection.

For EdNA Online, Type 3 data is a key to engineering new flexibility into the information retrieval and resource discovery functions of the website through the design of user-customised pathways. Conceptually, it also acts as a useful abstraction from which to develop mechanisms to support and promote online collaboration and online educational culture. It is expected that the practical implementation of this can inform the development of appropriate specifications for the 'collaboration' module within the Instructional Management Systems (IMS) Project [IMS 1999].

From a design point of view the application of Type 3 data enables the dismantling of the rigidity of a hierarchically branched (drill-down) category structure and re-rendering it depending on user entry points. This is achieved through the development of a small master set of categories supported by a controlled vocabulary and the use of metadata. This opens the opportunity for a much tighter integration between the browse and search functions and further allows the definition of new pathways to information which can be to saved, exported and shared as educational objects of value.

The model presented here using 'Types' of data bears some resemblance to Tim Berners-Lee's *Metadata Architecture* [Berners-Lee 1998]. However, we see the need for a model which extends further into interactive services, EdNA Online being very much a test-bed in distributed administration as much as it is in the sharing of aggregated educational resources. Berners-Lee's definition of 'resource' is our Type 1 data. His notion of metadata is close to our Type 2 data. An important point here is that our model is not intended to be constrained by its own attempts be definitive – our definition is intended to be flexible enough to accommodate other forms of Type 2 data not yet revealed.

For our purposes, Berners-Lee's notion of 'link' can be seen as Type 3 data. In contemplating the possibility of innovative uses of other forms of Type 3 data our model extends beyond links as they exist in hyperlinks themselves. Hyperlinks are certainly one of the most important examples of Type 3 data and in many ways the fundamental technology of the Web. Perhaps it may be just wishful thinking but we believe that creative application of Type 3 data will be a key in propelling EdNA Online into its next stage of development.

Both the data models presented above are currently providing EdNA stakeholders involved with progressing development of services for EdNA Online with a tool for conceptualising a 'best-fit' approach to matching the requirements of human networks with available online technologies. The central commonality of the data model(s) with the collaborative framework of EdNA can be seen in the processes of pursuing 'added-value'.

5. Conclusion

Throughout the development of projects associated with EdNA Online, value-adding can be seen to be a common feature. Collaboration within the EdNA framework can be seen as the pursuit of mutual benefit. At the same time, value-adding can be viewed as an intrinsic opportunity that exists in any network, online or otherwise. In acting on this recognition through implementing a range of strategic initiatives, EdNA can be seen as developing a framework for lifelong learning support. Coupling the flexibility of multiple user pathways with concepts such as the linkages is expected to provide a very powerful means of resource discovery.

Achieving these aims will require an ongoing balance between taking advantage of the opportunities provided by an expanding range of enabling technologies and the promotion of facilities which result in the maximum benefit to EdNA users.

6. References

[Berners-Lee 1998] Berners-Lee, T. (1998). Metadata Architecture http://www.w3c.org/DesignIssues/Metadata

[EdNA Online 1999] EdNA Online http://www.edna.edu.au

[IMS 1999] Instructional Management Systems Project http://www.imsproject.org

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How to Make Discussion Forums Work on the WWW

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Abstract

It has often been claimed that networks like the WWW must not be seen just as huge distributed information systems, but rather also as systems that allow transactions, cooperation and communication. In this paper we discuss the technical features necessary for a good discussion forum, the fact that it should be really seen as part of a more general cooperation space, and psycho- sociological aspect that are essential for success.

1. Introduction

It has often been claimed that networks like the WWW must not be seen just as huge distributed information systems, but rather also as systems that allow transactions, cooperation and communication.

One of the most obvious tools for communication is the discussion forum. Indeed, see e.g. [Parsimony, ETI, Talkcity, Delphy], there are quite a few such discussion forums on the WWW. However, it is interesting to note that (a) a high percentage is used only quite infrequently, (b) they are often combined with other functions such as chats, see e.g. [Talkcity] and [Delphi], and that (c) the "older" type of discussions, news groups (outside WWW), are still very much alive, although more and more with cross-references to the WWW. It is worthwhile to examine why newsgroups, overall, are more successful than discussion forums, so far. We believe that there are five main reasons: (i) one is that all newsgroups are found in one place, rather than distributed over thousands of WWW servers; however, there is also a tendency today to combine many different forums in the same place: [Parsimony] is a very good example or to establish a "ring of forums" (where one forum leads to others), (ii) many desirable features that are conceivable are not available in discussion forums yet, e.g. the subscription technique (that new items are automatically shown when one has subscribed to them: this is a standard feature in news groups, yet is oddly missing in most discussion forums) (iii) access to news groups is often faster due to the extensive duplication/ propagation tools involved. (iv) discussion forums should be seen in a wider context as general cooperation tools (GCTs), and (v) many psycho- sociological phenomena one should be aware of when installing communication facilities are often blatantly ignored. It is our belief that discussion forums on the WWW will eventually replace newsgroups, due to the greater versatility of the WWW, particularly if they are used as true GCTs. In this paper we will report on some of the findings of our research on which conditions must be met to assure the success of a WWW discussion forum. This is based on the analysis of both successful and not so successful forums and techniques. Thus, this paper should be of interest to anyone intending to set up and operate a successful system for sharing and exchanging ideas:

The most important observations are that a successful discussion forum must of course be satisfactory from a technological point of view (and we mention some important parameters in [Chapter 2]). Yet at least as important are aspects of a socio- psychological nature (and we list some of them in [Chapter 3]). And that, finally, discussion forums, to be truly successful, should turn into general cooperation tools (GCTs) as explained in [Chapter 4].

2. Technological parameters

It is important to understand that discussion forums must have a solid functional (technological basis) and user-interface, yet this is not enough to make them succeed. Other often overlooked yet more important issues are on a psychological level as we will discuss in [Chapter 3] and that discussion forums must not be seen in isolation but as GCTs with features such as described in [Chapter 4].

There is also another aspect that needs careful consideration: discussion forums can serve rather different purposes, and as such may have to vary from application to application. To be more specific, consider two rather different applications: One, a discussion forum on certain medical issues, the other a discussion forum related to some Web Based Training applications in a subject area the requires much learner participation. In the first case, see e.g. [Infomed], the discussion forum very often "degenerates" in a collection of questions and answers: users tend to re-visit the same topic many times to find out if new contributions have been added or if their question has been answered. Hence in such a forum it is of paramount importance that new information can be located readily or that users are actively notified if an answer to their query is entered in the forum. In a Web Based Training environment as mentioned, see e.g. [Dietinger 98], the forum is often more a "real discussion" forum, with a thread of arguments that users have to be able to follow easily, no matter how those "threads" diverge or again converge. And in both cases more than just plain vanilla flavored communication and cooperation should be supported.

It is clear that a forum must be easy and fast to use; yet this is in direct contradiction to the demand of some users for powerful functionality: Typically, in a thread of discussion some contributors may not be of interest and the option to make their contributions invisible should exist; conversely, some contributors always make such erudite remarks that almost independent of the topic one wants to see what they have to say. It may be desirable to only see contributions that are fairly recent, or those that have received good marks from other readers (yes, such a grading system as available in some recommender systems, see below, is a very powerful function); it should be possible to highlight contributions by domain experts and also possible to collect interesting contributions in a private workspace (or one shared with others); users should be able to link contributions that they think belong together, such links being visible only to themselves or again to a well defined group of users. One of the important functions is a notification mechanism. Although some forums such as [Infomed] (using push technology) allow users to be notified of new contributions in topics of their choice (much as has been a long tradition with news groups) it would be e.g. nice if users could mark individual contributions posed (by themselves and others) so that they receive a notification as soon as someone reacts to the contributions at issue; or that users are notified if a new contribution containing a certain word or keyword is added into the forum. Of course discussion forums must be searchable by content, keywords, author, title, etc., etc. The list of functions that come up in connection with discussion forums is sheer endless. However, each new function introduced also introduces more cognitive overhead (i.e. makes the user interface and the learning of the system more difficult).

There are three main approaches to solve this problem: one is to keep the user interface and the functionality to a minimum; the second is to have various modes for, say, beginners, more advanced and expert users; and the third one is to offer a naive user interface, but a choice labeled "functions for experts" or such, that indeed yields much more functionality.

However, there is one feature that is crucial to an extent that we want to mention it right here: participants of a forum may just work with an assumed pen-name, or with a real identity. In either case it must be possible to send emails to (or chat with) other persons: and if they use pen-names their "anonymity" must not be violated by such emails! Integrated email or a private chat forum that can be started by a consenting group of participants at any point in time are crucial instruments for making a forum work, as we will see in [Chapter 3]. However, there is increasing concern with privacy issues on the WWW as such, and this extends to discussions: if someone uses a pen- name, the identity of the person behind it must be hidden for everyone, except in cases that are in violation of the law. We refer to the thorough discussion on those matters to [CACM 99] and to the fact that at least seven levels of anonymity can be identified to [Resnick 97]. However, we want to point out here that a "certification" mechanism that permits to ask questions about some pen- name that are answered by a trusted server to an extent determined by the owner of the penname is a feature that is still missing in all systems we are aware of.

3. Non-technological parameters

As important as technological parameters like user friendliness, fast response times, a number of different access paradigms etc. may be, the best forum does not work if a number of psycho- sociological parameters are not right. The most important one of those is that there must be a "leader" or a "group of leaders". This does not mean that the forum has to be moderated (although a good moderator often helps), but it does mean that one or more persons should feel responsible for the forum to be "alive". Such persons can play this role because they explicitly started the forum with this function in mind, or such roles may emerge by themselves. It is not important that the leaders are "officially" known as having this role (although this usually is not a drawback): the only thing that counts is that they play a lead role:

Playing a lead role means carrying out at least some (and best all) of the following actions:

(i) Read all contributions in the forum and make sure that every question is answered, even if only by a temporary generic answer such as "This is an interesting question, I am also interested in an answer."

(ii) Make sure that questions are indeed answered in a meaningful way at some stage. This can often be done by someone playing the lead role in a hidden way, by e.g. sending an email to some participant who is suspected to know the answer in a way like " X has asked this question that I find interesting. I wonder if you could help find the answer?"

(iii) Point (ii) is the core of a more general issue: the combination of a forum and email (even if pen-names are allowed the email has to still work on the basis of those pen- names!) is essential. First, participants of forums sometimes want to discuss some things in private (starting a "private chat" or "private forum" may be alternatives to email); second, an important function of the lead role is to use email that is not visible in the forum to encourage participants, to solicit questions and answers, and to make sure that participants feel like they belong to a kind of electronic community. We want to explicitly acknowledge that this fact is already alluded to in (1) and was mentioned very explicitly by Lee Sproull in her keynote address at WebNet 98 in Orlando, Florida: and we can only emphasize her point: a forum without some participants that develop a minimal amount of bonding is usually doomed.

(iv) The development of a bond between participants of a forum can be fostered in many ways. The most personal ones are emails, thank you's in the forum and even common actions outside the Web (e.g. a forum on skin-cancer might support a donation campaign for research in this area, and progress of the action is reported). There are many other actions, some even automatable, that make or break a forum: if participants are asked for their birthday (not the year, please!) a "Happy Birthday" message is sent on time (preferably via a moderator who can add a personal note: nothing is worse than people believing they are treated personally and finding out that they are not!); if someone is a "frequent writer" this is gratefully acknowledged once in a while; if someone has not written for a long time, an email is sent to the effect "you have written such interesting contributions in the past; I have not heard a long time from you--- hope you are ok?". Note that those actions can be done by some "lead group" or can be automated to some extent: they must look personal and ideally they should be, the system just acting as a reminder.

(v) It is an important part of the lead role that persons are made aware of existing functionality, like "it seems you are very interested in how to deal with respiratory problems; do you know that you can subscribe to new contributions in the forum by doing such-and-such"; it is equally important that persons are brought together e.g. in the sense "I have noticed that person x is very interested in topic y; do you actually agree with the statements made?" (this could be an email or part of the forum).

(vi) A forum should have this personal touch due to an appointed or self-appointed or tacitly existing group of lead persons. However, the forum must also stay on track. It is not optimal if in a group on how to care for cats the whole forum becomes cluttered with "get well" wishes because some participant is known to have had an operation, or even worse with "Happy Easter" from everyone to everyone. Such exchanges should occur, but only to a certain level or in an isolated part in the forum, the rest by email or in chats or private forums.

The list above gives a good indication of some of the items that we have observed, and we hope they convey our message: a forum is dead if there is not at least one person constantly looking after it!

4. Discussion forums as part of a greater concept: general cooperation tools (GCTs) and general cooperation spaces (GCSs).

One important point to observe is that discussion forums can usually only be started by site administrators, are usually open to the general public or one well defined group, and are basically for writing comments (albeit possibly with some multimedia attachments). A General Cooperation Tool (GCT) does more: it permits all persons with write access to a part of the Server to define their own General Cooperation Space (GCS). Anyone creating such a cooperation space is a so-called facilitator for that particular GCS. Facilitators can make their GCS available with read and write privileges for whatever users they choose, and contributions can take any forms: notes, URLs, WinWord or PDF documents, pictures etc. Every entry comes with a short textual description, with optional attributes and an optional "grade". In conjunction with annotation and linking facilities as e.g. found in Hyperwave (see e.g. http://www.hyperwave.com/whitepaper, http://www.hyperwave.de/documentation, or http://www.hyperwave.com/hw_web_pages/delphi_opinion.pdf) such a GCS is indeed a collaborative environment to share e.g. bookmarks or other documents within the group defined by the facilitator. A push- functionality (akin to what is provided in Hyperwave as "query object") must allow automatic notification of participants of new entries at certain times, or depending on certain events and attributes. By also using various presentation strategies offered in the GCS, finding and sharing information becomes easy. By collecting information of particular interest in private areas of the Server users should be able to further personalize information according to their needs, including information residing in various GCS, or even outside such GCS. It is felt that such a GCT, by allowing the creation of arbitrarily many GCSs on the same server for different groups of persons is an ideal platform for communication and cooperation in Intranet and Internet environments.

Let us now look at GCTs and GCSs in some more detail. First, a GCT must be useable either in conjunction with ordinary Web Browsers or as separate application as a "floating window" while working with a WWW Server. It comes with different functionalities for the facilitator and for ordinary users.

A facilitator is any person that has write access to some part of the Server at issue. Typically, ever identified user should have a special personal area with write privileges: in this case, every user with a personal area can become a facilitator. A facilitator can establish one or more GCS with a space capacity as determined by the administrator. (When space runs out, it is up to the facilitator to ask for more, prune manually, prune using a utility provided e.g. by date, or set limits to the size of documents that can be added by users.) When establishing a GCS, a unique name has to be chosen for the GCS at issue and a number of parameters have to be set initially (and some can be changed and set also later) by the facilitator. The most important parameter is the list of users: the facilitator can include the emails of arbitrary persons who thereby become users of the GCS. However, any new user added becomes only active after the user (who is notified by email) agrees to be active. Also, users can leave a GCS at any time they desire, i.e. no user is ever in a GCS without explicit agreeing to be in it, and is free to leave at any time. Conversely, the facilitator may exclude any person at any time. Facilitators may permit self-registration for their GCS, or may insist that they install each user (one main difference is the anonymity of users, see below, and the fact that self-registering makes permanent exclusion of "nuisance members" complicated).

The facilitator may suggest one or more main topics: nobody else can suggest main topics, but everyone can suggest subtopics that are hierarchically structured to a level determined by the facilitator with some default (like e.g. 5 levels) preset. (Note that if the depth of levels allowed is set to one, then only contributions to the main topics suggested by the facilitator can be added.) The facilitator and only the facilitator can arrange, rearrange or delete contributions created by other users. The facilitator can designate himself or other persons for each main topic as "responsible", i.e. whenever a document is added in this topic an email to that extent is sent to the facilitator either immediately, or at certain times as designated by the facilitator. It is also the facilitator who decides whether additional attributes (like one of a set of keywords) has to be added to a contribution to later ease searching or the automatic posting of contributions with just certain properties: here the need for a powerful server allowing the addition of meta-data becomes essential.

When an ordinary user enters a GCS the view is very similar to what one expects in a newsgroup, or in the discussion forum of e.g. GENTLE see [Dietinger 98] and http://wbt.iicm.edu . A list of main topics is shown, and the contributions to the main topic can be expanded step-wise or "the whole thread at the same time" very much as in GENTLE. When a contribution is added, a short descriptive text is mandatory (and sometimes, in discussions, this is all that is required). An attachment is optional: such attachments can be a URL or list of URLs or some other document, including arbitrary multimedia files. Contributions can be given a "grade" between 0 to 10 (0 worst, 10 the best). Indeed such a grade can also be given when reading the contribution: the range of grades and their average is also shown for information. Only a single grade can be given to a document by the same person (to avoid "cheating").

When looking at contributions, users have a number of options similar to the ones mentioned in connection with discussion forums: indeed, one way to look at GCSs is to consider them very fancy discussion forums, of course: user can consult a GCS e.g. hierarchically (the usual way), but they can also sort the documents by author, by date, by date from a certain date onward, by opening the hierarchical structures only to the extent of showing branches that lead to documents that have been added after a certain date and by omitting contributions of certain authors ("blacklist"). Users can mark individual documents satisfying certain criteria (e.g. belonging to a particular topic or subtopic with an average grade higher than 6) so that information on them is sent at intervals they decide on (daily, weekly, bi- weekly or monthly).

A good GCT also supports "business cards" with information as provided by users. The business card has a pen-name chosen by the user, comes with or without picture, and whatever other information including email or phone number: clearly a "non-certified" business card without email or such may contain purely fictitious information! However, the GCT does keep track of the connection between pen-name and email (to which the password is sent): this information is treated as confidential except if opened for legal procedures. A GCS contains a messaging system that is based on the pen-names chosen, i.e. one- to- one communication is possible in a GCS, if desired. Note that the functionality of adding notes (both for private use or public with the GCS) should be supported, the same way as users should be able to create links even in material not authored by them (for their own use, or for the HCS). Such GCS- public notes and links are only visibly if the toggle "show notes of others " has been turned on by the facilitator, or is turned on by a user (in the latter case, notes and links are only visible during the current session for this user).

A GCT should also provide the "psyco- sociological" features mentioned in [Chapter 3] above. Indeed, everything that has been said so far is really an extension of "ordinary" discussion forums. However, there is one further feature that makes a GCT particularly useful: the book-marking facility. When browsing WWW sites users may find an interesting entry. Rather than making a bookmark for themselves on their PC they hit the GCT bookmark button, rather than the bookmark button of the browser. As a result, a list of groups in which they participate (potentially after identifying with name and password) is shown: they put their bookmark in the appropriate space with a short description (for themselves and others) and a "grade". Thus, the GCS is a powerful tool for bookmark sharing, an important feature for efficient WWW use.

Note that the bookmarks created can be checked for validity or changed contents by the GCT: the creators of bookmarks (and the facilitator if the toggle is set this way) can be notified if there is a potentially invalid link!

Thus, the list of shared bookmarks has a good chance to stay better up to date than any private list! When users find a bookmark that does not work, simply pressing a "bookmark does not work" button notifies the author and (see above) the facilitator.

5. Summary

Discussion forums have been around in the form of newsgroups for many years. They are also becoming more and more popular on WWW servers. None comes close to the functionalities described above, yet it is our belief that such functionalities are essential.

Note that a number of recommender systems [Resnick 97] have been around and are increasing in importance. A GCT can be seen as such a system where the recommendation (the grades, and the fact that bookmarks, i.e. URLs or other documents are added into the GCS) is coming from the fact that the group using a GCS is homogeneous and is supposed to have shared interests. Our approach is in line with the Personalized Recommender System, a prototype of which was developed by J.Horwarth and others under the guidance of Barry Fenn.

It is also conceivable that "recommendations" that come from similarities in judgement are exploited: this is increasingly done on some commercial WWW servers, and is pursued in recommender systems such as PHOAKS, ReferalWeb, GroupLens, Siteseer, Fab, Alexa and others. Also, the density and usage of links may be used to measure the importance of contributions, as is indeed done e.g. by the search- engine Google http://www.google.com . It is clear that powerful GCTs will be merged with some such attempts in the future. To put it into a nut-shell: discussion forums of the news group type will be more and more replaced by sophisticated WWW discussion forums that are really General Cooperation Tools. One such tool, called Hyperwave Cooperation Tool is currently being implemented at the institute of the second author.

References

[Sproull 92] Sproull, L., Kiesler, S. (1992). *Connections: New Ways of Working in the Networked Organization.* (Contributor); MIT Press.

[Dietinger 98] Dietinger, Th., Maurer, H. (1998). GENTLE - a GEneral Networked Training and Learning Environment: *Educational Multimedia, Hypermedia and Telecommunications*, 1998, Association for the Advancement of Computing in Education, Charlottesville, VA, 274 - 280.

[Infomed] Infomed-Austria: The Austrian Medical Portal Server. http://www.infomed-austria.at

[Parsimony] Parsimony: A collection of discussion forums. http://parsimony.net/forum/forenliste.htm

[ETI] European Teleworking Initiative: A combination of email and forum. http://webboard.eto.org.uk/~telework

[Talkcity] Talkcity: A commercially sponsored combination of forums and chats http://www.talkcity.com/mediakit

[Delphi] Delphi: Another commercially sponsored combination of forums and chats http://index.delphi.com

[C.ACM] Internet Privacy: Special Issue, *Communications of the ACM*, vol.42, no.2 (February 1999)

[Flinn 95] Flinn, B., Maurer (1995). Levels of Anonymity. *Journal of Universal Computer Science*,vol.1, no.1, 35- 47.

[Resnick 97] Resnick, P., Variona, H. (1997). Recommender Systems. *Communications of the ACM*, vol.40, no.3, 56-58.

Idle Computing Resources as Micro-Currencies - Bartering CPU Time for Online Content

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Abstract

In this paper we present a brokerage system for using idle computing resources as a micro-currency for Web services hardly quantifyable with real currencies as downloading stock charts or accessing a search engine. The Locust (LOw cost Computing Utilizing Skimmed idle Time) system acts as a Broker for micro-payable services by demanding a part of the user's idle computing resources in exchange for accessing the service. We introduce the price/market model of Locust enabling the collection, aggregation and trade of resource surpluses or lacks between coupled sub-markets and eventually leading to an electronic resource market focused on the mainstream Internet user as supplier of idle computing time. We further describe Locust's inter-operable, secure and ubiquitous Web and Java based infrastructure to make micro-paying with CPU cycles for online content literally as easy as surfing a Web page with embedded banner advertisements.

1 Introduction

Wide-area Networks as Resource Pools The exponential growth of wide area networks – especially the Internet with its currently over 70 million nodes from over 58 connected nations – has lead to a drastic increase in the pool of available resources and to the need to access these heterogeneous resources uniformly. The potential of combined global computing resources has already showed up in a number of news-breaking distributed computing efforts, e.g. the decryption of assorted cryptographic algorithms as DES [5] and RC5 [14] or the search for mersenne primes and extraterrestrial life (SETI, [9]).

The need for uniform access to distributed resources has spawned a number of meta- and web-computing and resource brokerage frameworks addressing this problem. While meta-computing systems offer access to dedicated hardware and permanent resources by means of highly efficient, low-level programming models and protocols, Web-computing infrastructures as Locust target casual users and resources of the World Wide Web which are only temporary online and available for exploitation, by means of interoperable, secure and ubiquitous Web technologies as Web Browsers, Java and HTTP. Resource brokers act as a meeting point for demand and supply and thus provide an electronic market place for idle computing resources.

Goods and Services of Resource Pools Our vision is to harness the idle computing resources of millions of anonymous World Wide Web users temporarily connected to the Internet and transform these resources from crude and heterogeneous to standardized and homogeneous marketable services similar to other services already available on the Web, but on a much larger scale. Homogeneous goods and services already marketed include disk space provided by `httpd`, email and name service provided by `sendmail` and `bind`. The universal access tool for these services is the Web browser. These standard Web services are completely homogeneous and exchangeable like electric current coming from one provider or another allowing a demander to switch service providers anytime if not content with the service offered to her. A standardized interface for a computing or processing service – the `CGI` interface is not suitable for serious distributed applications – has not yet emerged on the Web though. So we strive to produce the electric current that fuels the applications of next generation computational grids.

Economic Model and Brokerage Computing time is a typical representative of resources with immediate expiration if unused. So every user of an idle machine should be thinking about ways to save his otherwise unused resources from decay. Locust's economic Price/Market model enables the export or import of resource surpluses or lacks between so-called submarkets and thus enables spare resources to pay off or to build stocks for future usage. Traditional resource allocation strategies have severe drawbacks outside of closed systems. Economic strategies however concurrently allocate several resources by efficient decentral decision making. The local self regulation between supply and demand is a key point to the management of large resource pools.

Architecture We propose a brokerage infrastructure called *Locust* (LOw cost Computing Utilizing Skimmed idle Time) based on interoperable, secure and ubiquitious Web technologies, i.e. Web browsers and servers, Java applets and HTTP. The usage of Web applications and protocols extends both the ease of participation and the target audience. While other Web-computing frameworks are collecting parallel tasks and distributing them to World Wide Web users with idle computing resources, Locust treats this scenario from a different point of view. We rather are collecting idle computing resources from casual WWW users and distributing them to programmers with parallel tasks to be executed. Locust achieves this by accepting parallel tasks in form of Java applets, embedding them into attractive Web pages and dynamically scheduling them onto anonymous Web users accessing those Web pages.

Outline The rest of this paper is structured as follows. In the next section we sketch deficiencies that sparked our own work by giving an overview of related work. In section 3 we present the necessary prerequisites to use idle computing ressources as a micro-payment system including a price/market model and its application to realize micro-paying and trade. In section 4 we present the technical issues, the implementation and applications of Locust. We conclude with a summary of the features we think make Locust unique both as a a micro-payment system and a web-computing framework.

2 Deficiencies of Related Work

Before we present the main topic of this paper we would like to shed some light on deficiencies of related work that sparked our own efforts in the field of computing resource brokerage. Among these works are ReGTime [6], a broker system for marketing and using computing power on idle workstations, the cypher breaking metacomputer of `distributed.net` [4] and Dampp [15], Jet [10] and Javelin [8] – interfaces to meta computing facilities based on Java. They all share common features as infrastructural overhead, demander orientation and volunteering.

Infrastructural overhead Current web-based distributed computing systems try to add or circumvent features lacking or featuring the Java virtual machine in order to deliver a full-grown parallel computing environment. These enhancements include applet-to-applet communication, fault-tolerance, load balance by work stealing, consistent checkpointing, high availabilty by redundancy and encryption. This considerably adds overhead to the already prevailing drawbacks of wide area distributed computing as poor network latency and bandwidth and slow Java byte code interpretation.
ReGTime as the only real resource bokerage system focuses the formal and legal aspects of selling and buying idle computing time. In order to enable controling and accounting of resources additional software overhead is granted as necessary i.e. maintainance of seperate logins and such. Thus the (architecture dependent) installation of ReGTime is more a matter of hours than minutes.

Demander orientation All related projects are clearly more oriented towards the sparse demanders than to the thousands or hundred thousands of potential suppliers of idle computing time. A parallel programming environment is provided from the programmer's or user's point of view neglecting the fact it takes several magnitudes more suppliers than demanders if an resource brokerage framework shall work out and propagate in practice.

Volunteering - Lack of Incentives All systems lack an effective incentive to propagate the acceptance and usage of their systems. Most environments completely lack any motivation at all for suppliers to donate idle CPU time. They set their hopes in volunteer computing and address their target group in the scientific and computer science field.

ReGTime brings together supply and demand in a resource spot market without any pre-information about a possible price – the negotiation is left to supplier and demander. So before contacting a ReGTime broker a potential supplier or demander has no hint how much resources he is going to get or supply and at which price. This situation is far from suited to successfully establish an electronic resource market.

A few others as `distributed.net` feature a kind of abstract motivation as feelings of community or feelings of doing something 'good' by joining i.e. the proof of the inefficiency of the DES algorithm for ensuring privacy ([4]). In [13] this feeling is referred to as *bayanihan*, a "community spirit of unity and cooperation that makes seemingly impossible tasks possible through the concerted effort of many people". These incentives, whose value is hard to quantify, make the success of a resource facility subject to good will or luck and – depending on the situation – may work or may not.

3 Micro-Paying with Idle Computing Resources

All of the Java based distributed computing environment described above share some common conceptual deficiencies leading to a limited acceptance among potential users and inhibiting the propagation of resource brokerage. In the following we propose new paradigms – ease of participation and supplier orientaion, low overhead, working incentives and an economic marktet model – which heal most of those deficiencies and could give way to establishing an electronic resource market. By making joining a distributed computing orokerage system and providing cpu cycles as easy as surfing a Web page with embedded banner advertisements, idle computing resources have the potential to become a marketable Internet good similar to other goods as web space, banner placements and advertisement clicks.

Supplier Orientation As it takes several magnitudes more suppliers than demanders if a resource brokerage framework shall work out and propagate in practice, an initiative addressing anonymous Internet users – the Internet *mainstream* – should be as simple and intuitive as possible. Meta-computing systems though are more oriented towards the sparse demanders than to the thousands or hundred thousands of potential suppliers of idle computing time requiring them to visit a certain web page in order to donate resource. We think this is far from being easy enough.

Besides, a computational applet for comsumption of idle cpu time will, in the mainstream user's point of view, do *nothing*. No flashing messages, no moving animations, nothing. As the surfer is not rewarded directly we cannot rely on any action of him to donate resource, instead we must make sure the applet does its work even without interaction by making it running *automatically*. In short: If we cannot make the supplier come to the worker applet, we have to bring the applet to the mainstream supplier. We will shed more light on this point in the next paragraph *Incentives*.

Incentives - Finding the right price Most computing environments cited in this paper have no incentive at all to move potential suppliers to supply computing resources. We propose a two-way approach to the problem of an effective incentive.

First, we propagate idle computing time as a replacement of money or micro-currencies on the Web, a tendency that can already be observed in some parts of the commercial Internet. In online advertisement business, banner placement, page impressions and ad clicks are sold by webmasters (to finance expensive bandwidth), bought by the industry (to reach their target groups) and – eventually but literally – paid by the average Internet user for the access of an attractive online content, be it access to an online database or up-to-date news [1].

Online advertisement is thus already used as a micro-currency in order to pay for hardly quantifyable online services as visiting a web page, downloading brand new stock charts or accessing a search engine. None of these services are *free* as it may appear to the surfer. All of them are guarded by a small animated or flashing customs stations invisibly demanding a small toll for accessing the site. We are sure that the mainstream surfer will be accepting worker applets just like he has accepted banner ads on his favourite web sites, worker applets literally doing *nothing* but skimming his idle cpu time. If we make joining a distributed computing brokerage system and providing cpu cycles as easy as surfing a Web page with embedded banner ads, then (micro-) paying for online content with cpu cycles will become common practice.

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[1] This phenomenon was recently backed up by an open letter of Clearway, Inc. accompanying the withdrawal of their ad blocking *Adscreen* software after only ten hours [11]. In this letter, Mark Kriegsman, President of Clearway, recommends **not** to block any ads lest starving out *free* web sites either being forced to shut down or charge memberships for access.

Second we think that the most natural means of payment for an resource market are computational *resources* themselves. Conversion from and to real money raises transaction costs and may be superfluous if suppliers want to spare idle computing time during the night or weekends and consume accumulated resources – less a certain amount for the commisssion – when having increased demand for it.

Low overhead - keep it simple Most of the related work in this field, ambitious and elaborate projects with powerful features in order to deliver a full-grown parallel computing environment (so-called *infrastructure, framework, toolkit*), considerably add overhead to the already pending penalties of wide area distributed computing. In our opinion an initiative addressing the Internet mainstream should be embarassingly simple. It is questionable if the end user is going to use a distributed meta-computing environment he does not understand and that sends him encrypted worker applets of unknown origin to do encrypted computations of unknown good and kind.

Openness Security issues take up a substantial part in the efforts of distributed computing infrastructures to deliver a traditional parallel computing environment. Other systems enforce correctness, privacy and safety of the involved code, data and results by means of encrypted processing, cross and statistical checking, checksum methods, redundant computation and task splitting into parts too small to reveal useful information.

We discourage from any method for enforcement of security issues going beyond the features of the Java Virtual Machine. Distributed computing on the Internet is not (yet) for businesses with sensitive proprietary data. The reason why Internet computing projects exist is not the Internet's fundamental qualification for distributed computing but mainly because it is out there and it is dirt cheap. So idle cycle computing, once established, will be a low-cost niche market with a number of inconveniences such as latency, bandwidth, security and timeline constraints that will be made up by an unbeatable price-value-ratio. Professionals and businesses seeking for secure parallel job processing should stock up their budget for computing time in a computing center.

Model for a Resource Market Outlined in the following we present a model for the establishment and management of an electronic resource market.

Asymmetric Model

A resource market focused on casual WWW users is characterized by its asymmetric structure: there are many potential suppliers of small quantities of computing resources and only few demanders of aggregated amounts. This fact justifies a stronger orientation of a resource market to the supplier side and an enforcement of easier market participation for resource suppliers than resource sinks.

Decentral Hierarchical Management

By establishing a hierachy of intermediary traders we can have the resource market handled efficiently and decentrally by local traders each following individual policies for accessing and aggregation of resources. These policies may be defined by individual target groups, transaction costs, administrative domains and so on. Additionally, market participation should be the easier, the lower the abstraction level is. Suppliers participate as local markets with resource surplus, demanders as submarkets with resource lack.

Incentives for Market Participation

To reduce transaction costs as much as possible we propose the usage of micro-currencies for suppliers of computing resources in low hierachical levels of the market model. Exchange to real currencies will be offered only for accumulated resource amounts in higher levels of the trader hierarchy.

4 Locust – Infrastructure and Applications

Infrastructure The current prototype of Locust [1] is collecting resources by *Content Providing*. We have written Java applet code to download, test and return tasks from a Master Java application located on the Web server. The so-called *Locii* applets implementing the worker role of embarassingly or brute-force parallel applications are embedded into the Web pages of a search engine. The so-called Locust *tasker* – responsible for determining the capabilities i.e. the hardware and software of a connected Web-terminal and scheduling an appropriate task to it –

consists of a Java servlet running on the search engine Web server. Combining the Web server and the tasker on the same machine might form a potential bottleneck but is necessary to suffice the restrictive security aspects of the Java Virtual Machine. The communication between tasker and *Locii* for job asignment and return of results is done via light-weight UDP.

By placing the *Locii* applets on frequented Web sites and skimming its visitor's idle computing resources, Locust is able to create a working distributed computing scenario on the fly delivering encouraging performance [2]. In contrast to other works on Java based distributed computing we emphasized our approach to be as simple as possible and to make up the simplicity and the performance lack of Java by the sheer number of concurrent applets. We have made yet no further efforts to support extended scalability, load balancing or further communication routing.

Suppliers and Demanders Locust currently relies on so-called *Web-Terminals* – arbitrary, temporarily connected hardware under any operating system capable of running a Java-enabled Web browser – as suppliers of idle computing resources. Their incentive to provide resources is an abstract micro-currency saving trasaction costs: access to attractive Web content. Alongside it is possible for owners of computing clusters to donate spare resources by installing the *Locii* applets as Java applications.

The role of the intermediate traders in the market model is adopted by world Wide Web content suppliers collecting idle resources by embedding *Locii* applets into their Web pages. Intermediary traders are rewarded by cash for accumulated resource amounts similar to accounting for banner placements or ad clicks.

Currently we consume the accumulated cpu resources ourselves for raytracing and RC5 decryption which is described in more detail in the next section. However we anticipate SOHO offices and small businesses as enduser demanders of those resources in the future. Eventually we foresee meta-computing projects to further process our basic resources into a standard meta-computing service.

Applications Basically Locust works with every Java applet, we are even evaluating our system as a substrate for executing cooperating Java beans on the Web. But only parallel and distributed applets exhaust the full potential of web-computing with idle resources of hundred thousands of anonymous nodes. Because of the inherent latency and security constraints of the Internet and the Java sandbox model we have to confine to embarrassingly parallel or brute-force application, the prototypical problem class for every distributed meta-computing scenario. These properties are best implemented by using a master/slave computation model. The master splits the main problem into sub-problems and distributes them to the slaves that he keeps track of. Upon completion of their sub-tasks slaves return the sub-result to the master and trigger a new sub-problem being sent. In the RC5 case the RC5 key space is divided into keyblocks and distributed to the slaves which check them against the known plain text. Their return value for a completed key block is either Key found or No key found. The Master code we used was implemented by Laurence Vanhelsuwe [15].

Java Optimization One of the features of the RC5 algorithm implementation is its simplicity and independency from hardware acceleration, hence it is straight-forward to formulate the algorithm in C and with a little more effort in an object-oriented language as Java. Due to the lack of mathematical functions support in Java only moderate speeds were achieved by this naive approach with the initialization, setup and encryption methods implemented straight-forward by means of loops. In order to achieve acceptable performance compared to native implementation all loops were unrolled in above methods. Benchmarks show that the RC5 applet can achieve – under an efficient implementation or plug-in of the Java virtual mashine with just-in-time compilation – up to one fifth of the keyrates of native implementations with optimized assembly core. So by just using more than five worker applets any native RC5 application can be recovered and outperformed [3].

5 Conclusion

We have investigated merits and deficiencies of current Java-based distributed computing and resource brokerage frameworks realizing that related approaches suffer from common misconcepts leading to poor acceptance and usage of idle computing resources. We disagree to related works centering around the extension of the Java sandbox model in order to supply a full-grown, user-oriented distributed computing environment for traditional parallel applications.

Instead we suggested new concepts – easy participation, working incentives and supplier orientation embedded in an economic market model – solving those deficiencies and giving way to a fuller propagation of an electronic resource market. The prototype implementing this simple and light-weight approach is *Locust*, a framework for skimming and consuming idle computing resources of WWW users in exchange for online content.

Ease of participation and a broad target audience – crucial for a framework focused on the mainstream Internet user as suppliers of idle computing resources – is achieved by means of inter-operable, secure and ubiquitious Web technologies as Browsers and Java. By placing embarassingly parallel tasks e.g. RC5 decrypting applets on a frequented Web site and joining its visitors into an instant distributed Web-computing scenario, Locust is able to deliver encouraging performance. Future versions of Locust will address further aspects of the economic market model, such as coupling of sub-markets and trade of resources.

References

[1] Michael May. Locust Home Page. `http://wwwbode.in.tum.de/~maym/locust/`

[2] Michael May. Locust - A Brokerage System for Accessing Idle Resources for Web-Computing. *25th EUROMICRO Conference (EUROMICRO'99)*, Milan, September 1999.

[3] Michael May. Distributed RC5 Decryption as a Consumer for Idle-Time Brokerage. *Workshop on Distributed Computing on the Web (DCW'99)*, Rostock, Germany, June 1999.

[4] Bovine RC5 Cracking Effort. `http://www.distributed.net`

[5] Federal Information Processing Standards Publication 46-2. Data Encyption Standard (DES), December 1993.

[6] T. Ungerer A. Huber. Regtime - eine neue Serviceleistung im elektronischen Markt. In *Workshop Ökonomie und Modellierung Elektronischer Märkte im Rahmen der 4. Deutschen Tagung Wissensbasierte Systeme, XPS-97*, 1997.

[7] Klaus E. Schauser Albert D. Alexandrow, Maximilian Ibel and Chris J. Scheiman. Superweb: Research Issues in Java-based global Computing. *Concurrency*, June 1997.

[8] Mihai F. Ionescu Michael O. Neary Klaus E. Schauser Bernd O. Christiansen, Peter Cappello and Daniel Wu. Javelin: Internet-based parallel Computing using Java. *ACM Workshop on Java for Science and Engineering Computation*, June 1997.

[9] David P. Anderson, Dan Werthimer. SETI@home: Search for Extraterrestrial Intelligence at Home. `http://setiathome.ssl.berkeley.edu/`

[10] João Gabriel Silva Tavares Jose M. Hernâni Pedroso, Luis M. Silva. Web-based Metacomputing with Jet. In *ACM Workshop for Java for Science and Engineering Computation*, University of Twente, Netherlands, June 1997. World occam and Transputer User Group (WoTUG), IOS Press, Netherlands.

[11] Mark Kriegsman. An open letter to web surfers and webmasters, Clearway, Inc., December 1998. `http://www.clearway.com/AdScreen/`

[12] Rivest Ronald L. The RC5 encryption algorithm. In *Proceedings of the Second International Workshop on Fast Software Encryption*, pages 86–96. Springer-Verlag, January 1995.

[13] Satoshi Hirano Luis F.G. Sarmenta and Stephen A. Ward. Towards bayanihan: Building an extensible framework for volunteer computing using Java. In *ACM Workshop on Java for Science and Engineering Computation*, June 1998.

[14] Inc. RSA Data Security. The RSA data security secret-key challenge. `http://www.rsa.com/rsalabs/97challenge/`

[15] L. Vanhelsuwe. Create your own supercomputer with Java. January 1997. `http://www.javaworld.com/javaworld/jw-01-1997/dampp/`

Ethical Considerations in Web-Site Design: Developing a Graphical Metric

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Abstract

> *" (we should do) good, not from inclination, but from duty."*[1] *from Groundwork of the Metaphysics of Morals.*

> *"Act in such a way that you always treat humanity, whether in your own person or in the person of any other, never simply as a means, but always at the same time as an end."*
> *Immanuel Kant*

Kant's belief that duty and respect should be the basis for interacting with our fellow humans forms the basis for many discussions as new technologies emerge. Each new technology that changes the type of information that is available and how it can be accessed opens up the need to review that technology in light of how the information is gathered, protected, and made presented. One technology that presents a variety of challenges worthy of this discussion is the World Wide Web and its supporting technologies. The Web has been more quickly integrated into business, academic, and personal life than any technology that has come before it, and yet it was not until long after its original deployment that discussion regarding accessibility issues began.

With the proposal and adoption of Web Accessibility initiatives around the world, it is time to carefully review the perceived ethical obligations to make websites "accessible" to the handicapped. This approach to web site design, while honorable, may not be realistic for certain types of sites and for users with certain types of handicaps. Using the Kantian view of duty and respect and Rawls' Ethics of Justice as the basis, certain criteria may be derived for evaluating the ethical responsibilities of web site designers and of web site users. These can be expressed as vectors on a planar graph, the size and direction of the vector providing information about ethical choices made by both the designer and the user.

This paper examines the accommodations both designers and users must make. In the process we develop and present a two dimensional plane of practicality vs. ethicality with our newly developed accommodation vectors as they apply to a variety of web design techniques and web deployment technologies.

Introduction

The AccessAbility initiative in Australia[2], the Trace Research & Development Center's "Designing a More Usable World" project at the University of Wisconsin[3], and the W3C Web Accessibility Initiative[4] offered for international acceptance are only a sampling of the projects[5] that demonstrate that there is concern among those who work in the Web world for their fellow web-surfers who may have limitations in their access. In addition to these initiatives, more web sites devoted to web design education are including discussions of ethical considerations in the design of web spaces for universal accessibility.[6] You can also find some discussion in the internet newsgroups with regard to the requirements for making sites more accessible to blind, physically limited, and even access-limited (slow access speed, limited band width, limited color depth on monitors) web users. There are also the discussions raised as part of classroom discussion in Ethics sources and in Academic conferences regarding the ethics of computing.[7]

With all of the discussion there is a surprising omission. The concentration has been on the side of encouraging and demanding web designers to make allowances for the potential range of limitations that a visitor to their webspace may have. What is not discussed is the obligation a webspace visitor has to meet the web designer halfway, hence meeting their ethical duty as a visitor.

We started with Kant's concepts of duty and respect in concert with the refined version of Rawls[8] concept of Justice as political fairness.[9] From their precepts we sought to codify a representation of ethical responsibility versus technical and consumer practicality using a plane. Along one axis we place practicality, with ethicality along another. We then plot vectors of the behaviour within web systems in this space. This approach provides more than a simple linear sliding scale of understanding of each party's obligations. Instead it provides web designers with a tool whereby they can decide if inclusion of a feature or a function for the sake of usability is ethically necessary or impractical at any cost.

Web Technology: Usability and Accessibility

For this paper we define usability in terms of the measure of a web-application's ease of use by anyone, regardless of limitations and disabilities. This includes such features as three-dimensional controls, accelerator keys, and scroll bars. We define accessibility in terms of the features a web-application has which support use by people with disabilities. This includes features such as user-defined font sizes, alternative input and output devices, and modifications to the usual input device behaviours.

Web technology evolved very quickly and it is certainly justifiable to say that most usability factors have been ignored or forgotten in the rush to the net. HTML does not easily support keyboard interfaces for interactive documents. There are no default behaviors for images and multimedia files to make them accessible to visually impaired websurfers. There is no simple way to enable a default button in all browsers (what the W3C call user agents). Rather, these usability features are provided (or not) by each programmer coding appropriate and sometimes highly elaborate routines in a scripting language.

Accessibility missed consideration in the first web browser designs, as well. While web browsers have, since the first version of Mosaic, allowed readers to change the size of the fonts in a document in real-time, few others accessibility features appear in the commercial browsers. Accessibility requirements have recently become more of an issue, however. The move of commercial businesses, academic organizations, and consumer groups to the web for information dissemination and customer support intensifies the concerns about accessibility.

The Problem

The theory of web technology is that it allows for a variety of usability and accessibility features to be made available to the user, not the designer. Button styles, colors, font sizes, input and output devices; all of these can be exploited to make the web-site in question more accessible to disabled users. But implementing an alternative technology for the benefit of these users comes with a cost. It requires more time to design, more time to code, and possibly more money to implement.

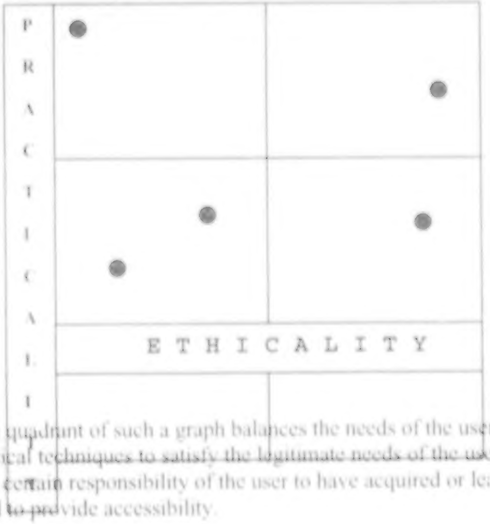
At the same time, both usability and accessibility are certainly desirable things; web designers attempting to communicate to a world should not limit the site to only the able-bodied. This tension between accessibility and practicality provides the potential ethical dilemma.

Do web-site designers and owners have an obligation to make their sites accessible? At what cost? What level of accessibility is the minimum allowable? Are all sites obligated?

A quick survey of the initiatives cited above gives a clear indication that the onus of providing accessible web sites to the masses is solely on the website owner and designer, with a passing nod to the browser manufacturers. However, using our premise of Kant's duty and respect and Rawls' political fairness as a basis, this hardly seems correct.

Surely there must be an ethical obligation on the part of a vision-impaired reader to learn about and utilize the font sizing ability of the browsers. But, does such an obligation extend to acquiring a Braille reader? A voice I/O device?

All such accommodation by both the web site designer and the web site user must be balanced on some scale of practicality vs. ethicality. To this end, we have developed a planar approach to measuring the ethical versus practical trades designers ***and*** users should apply when deciding how far accommodation for accessibility should go. The plot of such relationships could have been done as a quartile graph that plotted a subjective location of web sites on a grid as shown below:



A system in the Northeast quadrant of such a graph balances the needs of the user against the means of the designer. It employs practical techniques to satisfy the legitimate needs of the user without bankrupting the designer. It also implies a certain responsibility of the user to have acquired or learned about features which the designer has exploited to provide accessibility.

A system in the Southwest quadrant tends to represent a waste of time. The designer has implemented a site that does not provide much accessibility, but was difficult to create anyway and employs impractical and expensive techniques. For example, a system which requires a Braille output device to be attached regardless of the users situation is unfair to fully sighted users, partially sighted users, and even to unsighted users.

A Northwest quadrant system indicates the designer did not bother to incorporate much accessibility, but took practicality to the extreme. Many current web applications fall into this quadrant. Webspaces that use small fonts, large graphics with little explanatory text, and misuse tags are the primary culprits, and quite common.

Finally, a system in the Southeast quadrant is unfair to the designer. While meeting the fair needs of the handicapped user, it has done so at the expense of the designer. Highly impractical techniques have been employed to meet those needs. Such a system puts too much of the onus for accessibility on the designer and not enough on the user. An example would be a web application that implemented its own font scaling technology because the users refused to learn about how to use the engine available in the browsers.

The Accommodation Vector

Such quartile graphs are useful, but do not take into account the other dimensions of the problem. While we could have expressed the problem in a three space (and there are situations where this is appropriate) we decided that representing other dimensions of the problem as a vector quantity in the quartile space would provide more accessibility to audiences attempting to measure the accessibility of such systems.

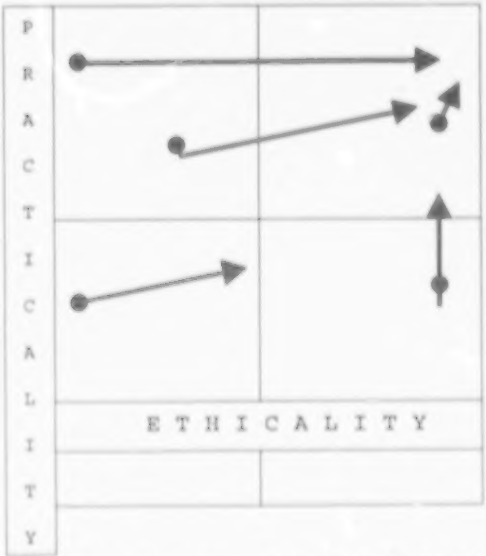
The quartile graph shows the location of a system as a dimensionless point; a snapshot in time, but also in attitude. A system designer may have a strong desire and intent to add more accessibility to a web application but not be able to do so in a practical manner at a given moment. In addition, a system evolves and may evolve toward the Northeast quadrant or away from it.

Therefore, rather than just plotting the static location of systems, we decided it made more sense to represent the ethical/practical tension as a vector. Vectors have a great many uses in the real world. They provide not only information about a location, but also about a starting point and about a direction. In addition, they encode magnitude, which we felt we could use to indicate yet another aspect of the tension between the ethical obligations laid on web applications and the practicality of accommodating those obligations.

Typically, for designers, the more practical a design is, the less ethical it is in terms of meeting a reasonable set of needs and requirements for an impaired user. We plot the evolution of a system by a starting point for the vector and by the direction its accommodation vector takes. We use the length of the vector to indicate the intent of the designer to provide more accessibility as it becomes more practical.

All web systems evolve over time and over time the cost of any individual accommodation falls. For example, it would have been very difficult to accommodate vision impairment with scalable fonts before the invention of true-type fonts in Windows. The cost of building or acquiring such an engine would be beyond the means of almost all persons who need it before Microsoft included in the Windows operating system. Once there, however, the cost of providing the ability to browser users was almost nil.

The quartile graph then begins to take on the shape shown below. It begins to represent a plane of vectors where the starting point, the direction, and the length represent where a system is and where it is going with respect to its ethical requirements for accessibility. In addition the balance between systems that require too much commitment from the user and those which require too much commitment from the designer is encoded and shown.



Conclusion

Web applications need to be designed with more accessibility for disabled and impaired users, but such users share a responsibility for learning the techniques available to make their use of a system enjoyable and useful. Designers must balance a desire for simple, highly practical systems with the needs of disabled users for sophisticated accessibility options. All users must balance their needs for accessibility with the practicalities of current state of the art technology and costs of development.

Representing systems on a plane as a state vector can be a useful way to show the relative success of web applications at balancing th[illegible]ension. Web designers can use this method to enter into discussion with site owners in discussing the merits of building in limited or extensive accessibility and usability features.

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[1] *Ka[illegible] translation by Paton, H.J. (1958) Groundwork of the Metaphysics of Morals.* Harper Torchbooks. ISBN 00613,1596. Also online at http://129.101.39.86/Philosophy/Kant_Immanuel/Introduction_to_the_Metaphysic_of_Morals

[2] See AccessAbility: Commonwealth Government Resources to Promote Web Accessiblity at http://accessibility.noie.gov.au for the Australian guidelines for web site accessibility now in use.

[3] See The Trace Research & Development Center "Designing a More Usable World" at http://www.trace.wisc.edu/world and specifically their section on web site guidelines at http://www.trace.wisc.edu/world/web/ for more information.

[4] See W3C Web Content Accessibility Initiative at http://www.w3.org/TR/WD-WAI-WEBCONTENT for the text of the proposal. Proposed 24 March 1999; review period ends 21 April 1999.

[5] See also http://www.trace.wisc.edu/world/web/owsag.html for a list of sites with Web Site Design Guidelines for accessibility.

[6] See Ethics & Design at http://www.sbrady.com/hotsource/ethocs as a good example of such a website.

[7] *Introna, L (1998). Conference on Computer Ethics, a Philosophical Enquiry (1998).* http://is.lse.ac.uk/lucas/cepe98.htm

[8] *Rawls, J (1993) Political Liberalism.* Columbia University Press. ISBN: 0231052499

[9] ibid. Page 5-6

Web-based Training: A South African Experience

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Abstract: The future of the people of Africa is believed to be determined through education, organisation and energisation [Mbeki 1997]. In building Africa's information society acceleration towards development plans, stimulation of growth and new opportunities in education, trade, healthcare, job creation and food security will raise the overall African living standards. To deal with the convergence in functionality of information, the education system in South Africa is forced to deal with the rapidly developing technological field. This paper reports on a web-based diploma that address a niche market to train subject specialists so that they may be able to manage information in their specific fields of expertise. The paper also reports on the statistical profile of the students, problems and pitfalls experienced as well as success achieved.

1. Introduction

Educational institutions are eagerly utilising the potential of the Internet and more specifically the World-Wide Web as a mechanism to deliver distance education courses to students. The Internet has eliminated national and international boundaries and has reduced the cost of transmitting information tremendously. Information is the latest word that is connected to revolutions. The information and communications technologies (ICT) revolution is believed to have had an effect the past 20 years [European Commission 1996]. In November 1998 a new word, also connected to revolutions, emerged when Thabo Mbeki [Mbeki 1997] mentioned the African Renaissance in which he recognises a central aim to provide a better life so that the people of Africa may determine their future through "education, organisation and energisation". The word also implies that this renaissance should be achieved by the people of Africa, not through an historical culture of begging, but brought about by them.

The African Information Society Initiative, according to Butcher [1998] believes that "building Africa's Information Society will help Africa to accelerate its development plans, stimulate growth and provide new opportunities in education, trade, healthcare, job creation and food security, helping African countries to leapfrog stages of development and raise their standards of living". Although the term "Information Society" refer to improving living standards in African countries, the definition for Information Society in first world countries refer to the integration of information technology in "industrial production and in information dissemination in all fields, one in which technology establishes completely new premises for production, distribution and consumption of information and the creation of knowledge" [Thornhauge *et al* 1997:8]. There appears to be a marginalisation between the development of the information society to act as an improvement for living standards, whereas on the other hand, it should create knowledge. The continuing growth of the Global Information Society creates a fear in some that it will accelerate the marginalisation of Africa [Butcher 1998]. However, Mbeki [1997] recognises that the African Renaissance cannot take place without globalisation and that the possibilities represented by globalisation will ensure that both rich and poor may benefit from globalisation.

Statistics for the number of Internet users indicates that one out of every 5 000 people in Africa, excluding South Africa, utilises the Internet. Compared to the world average of one out of 45, South Africa compares well with a ratio of 1:65. South Africa's relative status as an Internet user is in the 18th position worldwide [Butcher 1998]. The education and training system in South Africa must deal with the convergence in functionality of information, due to being exposed to rapid development in especially the technological field [Butcher 1998].

Companies in South Africa have realised that information, technology and the management of both these fields are of crucial importance in delivering improved services and products. Training in these fields will address a specific niche market, especially the training of subject specialists so that they may be able to manage information in their specific fields of expertise.

Such a group of subject specialists have enrolled for a two year Diploma in Information Management at the Department of Information Studies (Rand Afrikaans University). The need for subject specialists to gain experience in finding and manipulating electronically-stored information in their fields of expertise were realised and a Web-based diploma was developed. The diploma is offered and completed via the Web only, and although access to the Internet is essential, access to the Internet, as well as individualised tutorial training, have been provided to historically disadvantaged students. All study material including study guides, instructions and references are published on a secure Web site, accessible only to registered students. Although the diploma is offered as a distance education course, full interactive activity is promoted especially by means of electronic mail and discussion groups. All assignments that are completed by students are submitted as attached documents via e-mail.

The contents of the course represent the very latest international developments regarding Information Science and Information Management. Assignments are designed to provide hands-on experience through practical projects such as case studies and represent a problem centred approach to learning. The first study year of the diploma introduces information management on a personal level, followed by an organisational level to a strategic level of information management. The second year of the diploma entails advanced research work regarding a choice of four modules out of a possible selection of eight modules:

- Information Management Strategies
- Information Management Systems
- Information Economy
- Knowledge Management
- Electronic Publishing
- World Wide Web Management
- Internet Infrastructures
- Electronic Indexing and Information Retrieval.

Currently the diploma has its second intake of students for the first study year and the first registration of students commencing with the second year.

2. Statistical profile of the students

A total of 43 students enrolled for the diploma in 1998. The representation of these students in the workforce is divided into the private sector, universities as well as research or information centres. Students working in the private sector are 42%, in universities 28% and research or information centres 30%. Interesting to note that 77% of the students that enrolled for the course were female, possibly due to the impression that research workers and traditional librarians are mostly regarded as females. Of the 1999 student intake a slight drop in the female number with 73% that are represented by females. There were some cancellations during 1998. Of these cancellations 20% were due to reasons of ill health, 65% of a private nature and 15% due to technological problems preventing students to be able to work effectively. Two students from neighbouring countries enrolled for the course in 1998, one from Zimbabwe and the other from Namibia. The student from Zimbabwe had to cancel due to technological problems that could not be solved relating to the sending and receiving of electronic mail. The student from Namibia cancelled due to personal problems, but re-enrolled for the 1999 intake. The prior highest qualifications of the students that enrolled during 1998 vary between students that have only a bachelor's degree, those with a bachelor and a post graduate diploma, honours degrees, master and doctorates. Students with a bachelor degree makes up the biggest portion (46%) followed by students with a bachelor as well as a post graduate diploma (26%), then students with a honours as highest qualification (17%), masters students (9%) and lastly doctorates (2%).

The average pass rate of the 1998 student group was 68.217%. Nine percent of the students that wrote the examination achieved an average mark between 50% and 59%, forty eight percent of the students had averages between 60% and 69%, thirty percent of the students an average between 70% and 74%, and thirteen percent of the students achieved a distinction.

A total of 51 students enrolled for the 1999 intake. Interesting to note that the prior qualifications of the 1999 students differ somewhat from those of 1998. The largest group has a bachelor degree and a post graduate diploma (39%), followed by those with only a bachelor degree (29%), then honours (22%), then by doctorates (6%) and lastly masters (4%).

3. Problems and pitfalls

Students that were inexperienced with the Internet and also computers in general, initially had difficulty in getting used to the interactive environment. Some had no experience in sending electronic mail and had to be tutored via the telephone. Inexperienced students are often those from historically disadvantaged communities. Fortunately these students were also those that accessed the Internet from the in-house computer laboratory and they received individualised tutoring. As soon as the students became familiar with the computer and Internet environment their confidence improved, resulting in the improvement of their experience level and the overall success of their studies.

The largest portion of problems that were encountered was of a technological nature. As mentioned before, 15% of cancellations were due to technological problems that could not be solved. These students experienced frustration due to outdated hardware and networks. Some had difficulty with the Web browsers and electronic mail, which is specified by company policy. Another problem that was encountered is high levels of security on the student's computer which is specified by the company at which the student is employed, resulting in the prevention of the browser to be able to access certain sites.

The content itself of the course never proved to be a reason for failure. However, it was realised that the workload of the students was too demanding. They had to submit a document of at least five typed pages every week on their opinion and discussion of provided references. Every six weeks they had to submit a research report of at least 15 typed pages on a provided topic, but from references retrieved by themselves. After realising how demanding this workload was for part-time students, a minimum submission of two opinion papers and one research report was initiated. The workload of the student was decreased, but they still had to cover all the discussed topics for examination.

Another problem that was encountered was to reply and comment on the work that the students submitted. It is less time consuming to jot down a few remarks in pencil on a written assignment than to make knowledgeable sense through individualised replied remarks via electronic mail. In many cases undelivered mail, due to technological problems again, resulted in the re-sending of the remarks on assignments.

4. Successes

The greatest success lies within the content of the coursework. The student is stimulated to work independently on the most recent developments within the Information Science field. Feedback on the course content has in the two years never been regarded in a negative light. The students remark that they have grown to such an extent that they can handle information in their specialisation field with utmost confidence. They perceive the Postgraduate Diploma in Information Management as one that answers in their needs and one that address a specific niche were a specialist in a specific field may also be an information specialist in that field, more likely turning such a person into a knowledge worker.

Another success of the course that can only be ascribed to the electronic medium, in which it is delivered, is the fact that the content may be changed to the most recent developments within minutes. The tutor of a specific topic may have finalised and published the topic, just to retrieve a reference appropriate to that topic the following day. The reference can be added to the published topic and can be immediately available to the students.

The world economy is presently characterised by the phenomena of shrinking job opportunities and South Africa is no exception to this. The problem of poverty and unemployment in South Africa have not been conquered yet [Manual 1999]. Research by Lascaris and Hunt in 1998 indicates that 69% of young South Africans would rather work for themselves than in existing enterprises [Koenderman, 1998]. The Postgraduate Diploma in Information Management is perceived as one answering in this specific need of the South African environment. Students develop the skills of becoming entrepreneurs in the information field so that they can process information effectively for financial gain. They learn to use information technology effectively to achieve a competitive edge in a country where the information society is still in the early developing stages. They learn to create new marketing opportunities and to identify opportunities to develop new information products.

5. Conclusion

According to Margolis [1998] cost savings can be achieved through the elimination of classroom lectures. The educational and social situation in South Africa necessitates that more students be reached at a lower cost in order to develop the information society. This can be achieved by making use of the Internet, however, the technological infrastructure should be improved to try to eliminate the technology-related problems that were encountered.

Sinclair [1998:298] mentions that real teaching should be concerned with more than information and its transformation, but that it is concerned with mentoring, internalisation, identification, role modelling, guidance, socialisation, interaction and group activities. The Postgraduate Diploma in Information Management does not necessarily exclude these aspects from the learning situation. These activities can take place to a certain extent within the interactive environment that facilities such as electronic mail, chat rooms and discussion groups can provide. These facilities have not yet been implemented in the diploma, but are in future planning. With persistence, creativity and patience the Postgraduate Diploma in Information Management will reduce its problems, increase the success and turn knowledge and learning into...

"...commodities, with information being the chief currency through which participants buy, sell and trade in the educational domain" [Roberts and Peters 1998]

6. References

Butcher, N. (1998). *The possibilities and pitfalls of harnessing ICTs to accelerate social development: a South African perspective*. [Online]. Available WWW: http://www.saide.org.za/conference/unrisd.htm.

European Commission, (1996). *Green paper Living and working in the Information Society: people first*. [Online]. Available WWW: http://www.ispo.cec.be/infosoc/legreg/docs/peopl1st.html.

Koenderman, T. (1998). *Not just a bunch of ne'er-do-wells*. [Online]. Available WWW: http://www.fm.co.za/98/0904/focus/young.htm.

Manual, T. (1999). *Budget speech*. [Online]. Available WWW: http://www.gov.za/speeches/budget.htm.

Margolis, M. (1998). Brave new universities. *First Monday*. [Online]. Available WWW: http://www.firstmonday.dk/issues/issue3_5/margolis/index.html.

Mbeki, T. (1997). *Government speeches: African Renaissance*. [Online]. Available WWW: http://www.gov.za/speeches/index.html.

Roberts, P. & Peters, M. (1998). Information technologies and tertiary education in New Zealand. *First Monday*. [Online]. Available WWW: http://www.firstmonday.dk/issues/issue3_12/roberts/index.html.

Sinclair, J. (1998). Does the virtual classroom really exist...or is it still...out there. *The electronic library*, 16(5), 297-299.

The Design of a Web-based Multipath Exploration Environment for Constructing and Exploiting the Historical Events

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Abstract: In this work we present the design of an environment to construct and exploit historical events. The event can be a personality, a historical event or a time period. Various sources can be combined and presented according to their content and relevance to the selected event. The construction and the exploitation can be achieved through different paths. Those paths can broaden the event content or give a more narrow, deeper view. We avoid existing categorization and limiting factors to enhance user abilities to understand history.

Introduction

The aim of the educational procedures is to reveal a person's inborn aptitudes, give form to and activate inner potentials. Current scientific studies and practice for innovation of education emphasize the amounts of information which the students have to retain. The creation and provision of tools capable of supporting learning and knowledge acquisition can help exploit the potentials of this information [Metaxaki et al. 1996a] [Metaxaki et al. 1996b] [Tziva et al. 1993] [Collis 1996].

The presented application is an effort to use current technological advances and products to serve educational purposes. More than an information provider, the internet is supposed to promote dialogue and exchange of opinions and ideas. This could be a catalyst for the creation of mental interconnections and sequences leading to the acquisition of meta-skills.

The application refers to the European contemporary history and can be easily expanded to incorporate other countries. Our team is working on different aspects and tools for the history lesson [Metaxaki 1998]. We target to technology integration stimulating the interested parties to:

- investigate the underlying causes of historical events
- understand the general and specific consequences
- enhance abilities for information sources' selection and evaluation
- develop metacognitive skills.

In the following we present the designed environment, which is realized by widely accepted communication media and tools, of low cost. The application is interactive and easily accessible, without need of special training or equipment.

General Considerations

Studying History

Trying to enrich the usually poor content of the schoolbooks for history, we can come to the other end: the endless gathering of information sources and past events. We have to emphasize that the available information sources for contemporary history (newspapers, photographs, books, radio programs, TV and news shows etc.) are many more than for other periods. Moreover, historians and/or teachers, when selecting sources and past events very often limit them to their own views. Meanwhile, the application focuses on our century. There should be a quite serious selection of the facts to be named as historical events.

To overcome the mentioned problems we propose a process to exploit and shape a *global event*. The global event has a *virtual content* consisting of directly or indirectly connected views, opinions, beliefs, e.t.c. These are collected from a variety of sources and themes (historical sources, memories, news, arts, science e.t.c.)

This approach is actually a dynamic procedure of selections - comparisons - adoptions/rejections. The history lesson resembles an investigation/research procedure. In this way the underlying forces creating and moving history are recognized and understood , the consequences and effects are estimated.

One more problem for the realization of this approach is the existing time periods' taxonomies and categorizations, which express an already adopted view. They create difficulties for making projections and recognizing significance. We propose a categorization in short time modules-periods. These modules, without diminishing the existing ones, support the comparisons on inter-and intra country level. The modules can be accessed sequentially or randomly. The time module-period has four-year's duration and can easily be the Olympiada (the four years period between the Olympic Games). Starting from the last Olympic Games, and going back with time we reach the beginning of the nineteenth century.

The Classroom Settings

New didactic procedures and technological developments very early established an interactive mutual relationship, offering to each other means to develop and progress [Metaxaki 1997] [Metaxaki 1998] [Collis 1996] [Metaxaki 1994] . The new technological features (data transmittion, animation, sound - image - text coexistence, databases etc.) can be used to solve educational problems. "Telemathisis" (greek word formed from "tele-" and "mathisis"=learning) is one of the words used to name procedures, investigations and practices for learning and teaching.

In distance learning and teaching the traditional classroom gives its place to a virtual one. The interaction between the changing or not parties can be occasional and asynchronized (access to a common database of specific content), or systematic and constructive. In this last case, one of the interconnected terminals or nodes possesses a more responsible role, like a teacher in a classroom. This role can be interchanged or transferred by a predefined sequence and usually controls or suggests or coordinates the educational procedure.

In our system, the roles are interchangeable by transfer or expressed requirement. Teleconference facilities are provided. The content of the lesson can be selected pre-didactically for discussion or constructed during the contact hour. The accessed or collected information can stay in the system uncombined for re-exploitation and re-use. The system thoroughly promotes the *stochastic navigation* to find answers or *documentate* and *formulate* a *hypothesis*.

System Design Approach

Main System Modules

The proposed environment for the modern history lesson is presented in the block diagram of Figure 1. The system includes virtual modules, listings, selection boxes, main pages, figurative pages e.t.c. facts [Aisher 1996] [Kobsa and Wahlster 1989]. This makes the system easily accessible and supports the linking and the navigation , which can lead to the creation of mental interconnections.

There exist two types of virtual modules according to the content presentation, shown on the lower dark shaded part of Fig.1. There are modules for accessing the information content according to the time period (Olympiada). They are called *Time Main Period Modules* (TMPM). The other type are modules for accessing the information content according to the subject. They are called *Subject Main Category Modules* (SMCM). There are already implemented nine SMCM for: geography, nations, religion, life, political history, languages, arts , sciences, technology. The number is expandable through splitting or addition of other subjects.

All the virtual modules are implemented in hypertext form. The structure of their main pages is the same. As there are no specific modules for country information, but this is quite often needed, there is relevant provision. On each module page exist both the listing of countries and a *marked space* for each one. The facts or events are retrieved in text-, plain link - or icon link-form, depending on their importance and information amount.

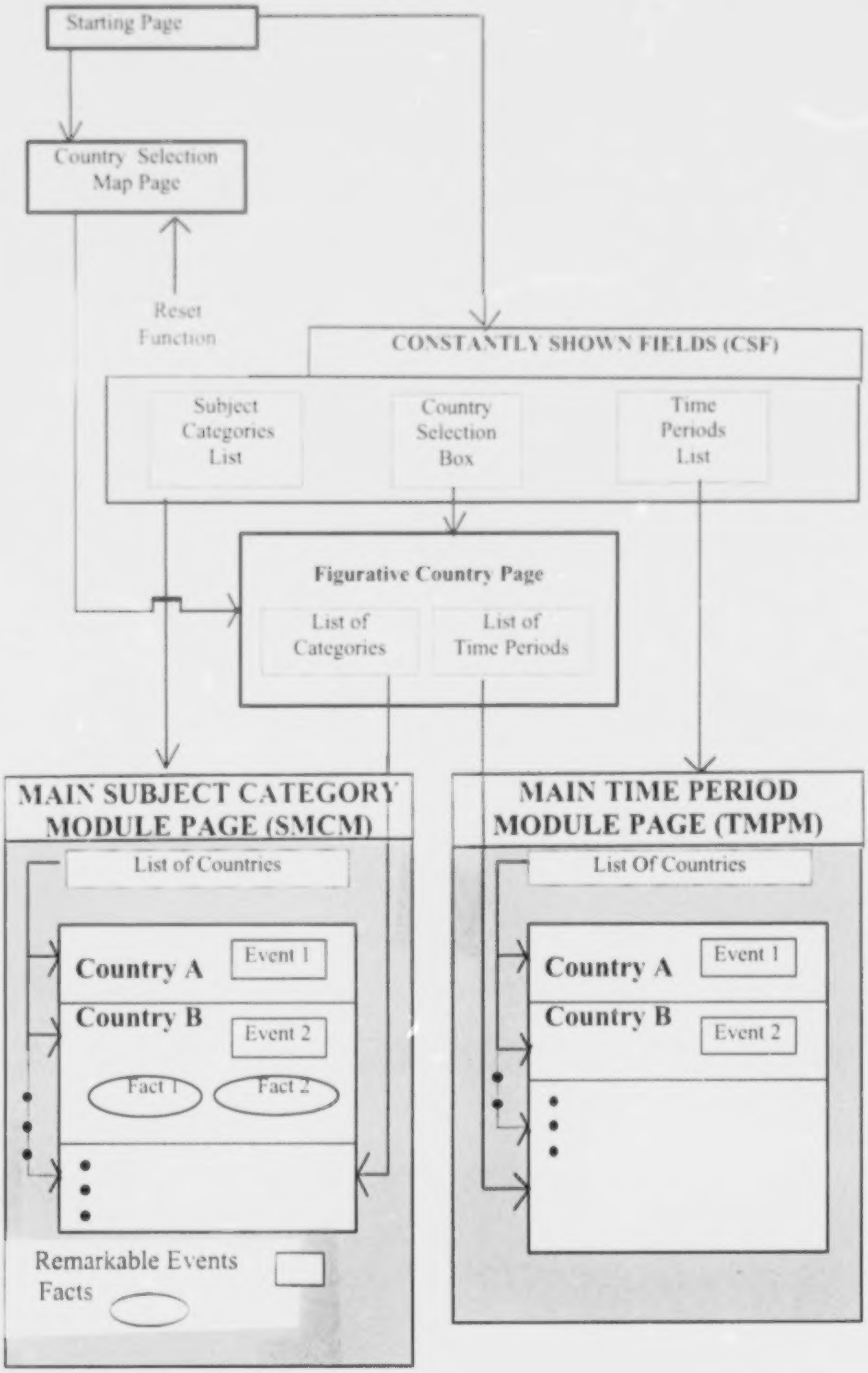
Starting Page
Country Selection Map Page
Reset Function
CONSTANTLY SHOWN FIELDS (CSF)
Subject Categories List
Country Selection Box
Time Periods List
Figurative Country Page
List of Categories
List of Time Periods
MAIN SUBJECT CATEGORY MODULE PAGE (SMCM)
List of Countries
Country A
Event 1
Country B
Event 2
Fact 1
Fact 2
Remarkable Events
Facts
MAIN TIME PERIOD MODULE PAGE (TMPM)
List Of Countries
Country A
Event 1
Country B
Event 2

Figure 1: Block diagram and Interconnections of the system

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Content organization

There are two virtual access organizations for the content of the system. One is according to the main time periods and the other is according to the main subject categories. This simulates the co-existence of different enclyclopaedias.
The information can be introduced or retrieved once and be clipped and transferred for accessing by the appropriate SMCM or TPCM. In this case the information looks independent of the structure of the system's modules. This does not yield always. We can have differentiations in the contained information i.e. there may be only a phrase for a piece of art in a battle description accessed by a time-period selection. The same piece of art can be presented by detailed description when accessed by the subject art selection. This differentiation provision serves the recognition of the context the global event is formed or investigated in.

System Functioning

The content retrieval and the event presentation can be adjusted in different ways. The selection of a way can be predefined for the lesson's need or/and be adapted to the dialogue evolution.
In Figure 1 we show the block diagram and the functioning capabilities of the system. The communication and the screens were designed and implemented to match the multi-path exploration and avoid sequential tracing, which is also permitted by default.
When the system is functioning, we reach the content of one SMCM or TMCM. To achieve this the user has to interact with the system and start a selection procedure. Whatever the selection, the procedure is always a two-step navigation.
The upper light shaded part of Fig.1 shows the ways we can communicate with the SMCM, TMCM. There is a central communication page which is organized in three frames. The one frame is the largest, and serves as the *Presentation Frame* (P.F.). All the information (text of main events, images e.t.c.) are shown in it. The other two frames appear on the page as *Constantly Shown Fields* (CSF) and do not change. They are placed on the two margins side-vertical and down-horizontal. The selection options provided on the CSF give us direct access to the SMCM, TMPM. By one more step the events and facts contained in the module are presented.
Together with them, the country name is always present on the specially allocated marked space. In this way an exploration on a certain subject can be overviewed in parallel for two different countries. To change module the user has always to go over the CSF. In this way, the user is always aware of the context the event or fact is stored and accessed in.
As there is no content organization per country we create an intermediate *FIgurative Page* (FIP) for each country. This page is not concrete. It is created by a cgi program starting by a country selection function on the CSF. During the system's trials, the users tended to start the navigation by country selection. Owing to that, another option for the FIP was added. It can be created through the bit map of Europe shown on the cover page of the system. Via the FIP page there is direct access to the marked space of the corresponding country. In case a global event is studied for only one country, inter-subject and inter-period navigation is needed.

Technological media and tools

Our aim was to create a tool which could be simple and of immediate use and appliance [Metaxaki et al 1990] Kouroupetroglou et al. 1995] [De Diana et al. 1994] [Smith 1991] [Metaxaki et al. 1996c]. For the implementation we have chosen currently used programs and common computer configurations.
The communication media is the WWW. The programming language was HTML, javascript and the required cgi programs were written with the use of the Bourne Shell [Reynolds 1996]. The working environment is Netscape Communicator, which is a tool that is quite spread and offers elements and services that support teleteaching's principles. Those are mostly the real time communication and the real time navigation through conference services.
The conference service offered is the chat tool, a real time exchange of written messages between the participants. This is done simultaneously with guiding and use of collaborative browsing.

An Example of Use

In this chapter we present a multi-path example of use. We start by Greek history. The simplest approach would be to study a time-period. Let us choose 1940-1944. There are two paths to be followed, both requiring two steps to match the two elements of the query (period-country).

One path is via the figurative country page [Fig. 1]. This page appears either from clicking on Greece on the bitmap or by choosing Greece from the country selection box on the CSF. After the FIP of Greece has appeared, we chose the years 1940-1944, through the time period selection box. As a result, we are guided to the marked space for Greece and can further access the events presented there.

Another path could be via the CSF. Through the time periods list, we are guided to the TMPM's main page. To view the events of concern, we choose Greece from the list of countries on the top of the page. The targeted link guides us to the space marked for Greece, where the events are presented.

When overviewing the content we can recognize the most important event, which is World War II. After this estimation we can proceed in a variety of ways, depending on the global event under study.

In case our global event is the selected time period, we can enrich this period by navigating through subject modules and broaden our views, comparing information on what happened between 1940-1944 in this country. The system offers opportunities to access information from other countries and make comparisons.

Another way could be to start from a small event e.g. that the opposition was using theatre shows for covert actions and start another navigation, concerning the role of arts and artists in the liberation battles. Navigating through other countries and other time periods, we could reach Picasso's "Guernica". Alternatively, moving to another country we could recognise the use of the first radar and start a navigation concerning technology (role, development, consequences). Another event is the absence of Olympic Games, which could be followed. All these different paths are actually changing the global event the users have started with. The scope of the lesson and the coordinator could select that path. We show in Fig 2 one of the working pages.

The mentioned example shows that working on broadening or overviewing a global event the users meet different sources, opinions and they have to make estimations, comparisons, adoptions/rejections.

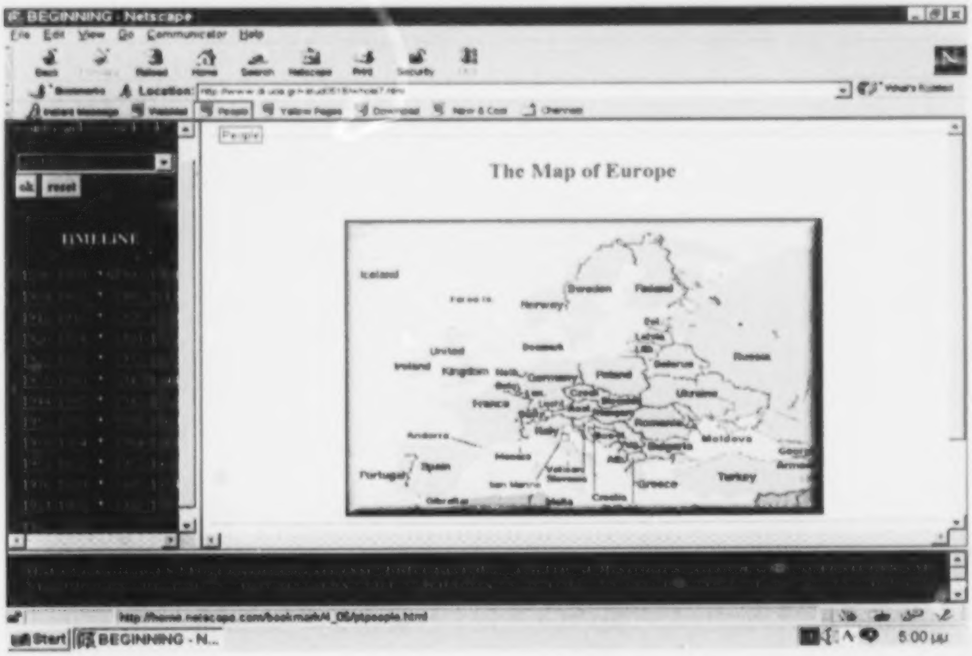
BEGINNING - Netscape
File Edit View Go Communicator Help
Back Reload Home Search Netscape Print Security
Bookmarks Location:
People Yellow Pages Download New & Cool Channels
ok reset
TIMELINE
People
The Map of Europe
Iceland
Sweden
Finland
Norway
Est.
Latvia
Lith.
United Kingdom
Denmark
Ireland
Russia
Belarus
Neth.
Germany
Poland
Belg.
Czech
Slovakia
Ukraine
France
Romania
Moldova
Andorra
Italy
Bulgaria
Monaco
Portugal
Spain
Vatican
San Marino
Albania
Greece
Turkey
Croatia
Gibraltar
Malta
http://home.netscape.com/bookmark/4_05/ptpeople.html
Start
BEGINNING - N...
5:00 μμ

Figure 2: A working page

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Discussion and Results

The system we present in this paper is an environment to study history using advanced communication technologies.

The environment is user friendly and easily accessible. The constantly shown fields of the communication page help the selection procedures. At the same time, the user does not feel lost navigating through countries and events.

The system prototype is fully expandable. We think that an intranet server could be very helpful, if constructed by repeated use of the system. The global event can be estimated and become the leading factor for the exploitation, without eliminating system capabilities. The virtual modules and their crossing to combine sources, views etc are supporting the global event study.

During the system development and design we tried to intergrate the technology in a learning process by proposing structuring for accessing, combining and linking. This is quite a difficult task, as the good and fruitful didactic techniques intergrating the communication technologies in a virtual classroom are still under exploration. We tried to preserve the system's flexibility for multi-path exploration and benefit of the large amount of information sources which can be compared and merged.

Our next scope is to let users of different background and ages interact with the system. In this way, we could improve learning procedures and estimate new evaluation parameters.

References

[Kobsa and Wahlster 1989] Kobsa, A., & Wahlster, W. (Eds) (1989). *User Models in Dialog Systems*. Berlin: Springer-Verlag.

[Metaxaki et al 1990] Metaxaki-Kossionides Ch. et al, (1990), "A Software Library for Image Processing Applications", Microprocessors and Microprogramming, Vol. 30, p.p. 333-340.

[Smith 1991] Smith, M. F. (1991). *Software Prototyping*. London: McGraw-Hill

[Tziva et al. 1993] Tziva, L. et al, (1993). A digital teleconference system for distance learning. *TeleTeaching '93, IFIP TC3*, August 20-23, Trondheim, NORWAY, 887-896.

[Metaxaki 1994] Metaxaki-Kossionides, Ch. (1994). Developing and Evaluating a Workstation for Teleteaching. *Telematics in Education: The European case*, (1994), (Ed) Wim Veen, Academic Centre Book, De Lier, 81-91.

[De Diana et al. 1994]. De Diana, I. et al, (1994). Towards an Educational Superinterface. *Journal of Computer Assisted Learning*, 10 (2), 93-103.

[Kouroupetroglou et al. 1995] Kouroupetroglou, G. et al, (1995). A Generic Methodology and Instrument for Evaluating Interactive Multimedia. *Telematics for Education and Training*, (1994), 24-26 November, Duesseldorf, Germany, (1995), IOS Press, Amsterdam, 343-350.

[Metaxaki et al. 1996a] Metaxaki-Kossionides, Ch. et al, (1996). Investigation of Learning by Visual Information. *Technology and Communication: Catalyst for Educational Change*, (1996), 13th International Conference on Technology and Education, March 17-20, New Orleans, USA, 1, 344-346.

[Metaxaki et al. 1996b] Metaxaki-Kossionides, Ch. et al. (1996). A Multimedia based Educational Environment for Training Students in Network Technology. *Technology and Communication: Catalyst for Educational Change*. (1996), 13th International Conference on Technology and Education, March 17-20, New Orleans, USA, 1, 350-352.

[Metaxaki et al. 1996c] Metaxaki-Kossionides, Ch. et al. (1996). A Software Tool for Educational Research in Pictorial Communication. *ED-MEDIA 96 Educational Multimedia and Hypermedia*, (1996), Association for the Advancement of Computing in Education, June 17-22, Boston-Mass., USA, 471-476.

[Collis 1996] Collis B., (1996). Tele-learning in a Digital World, *ITP, International Thomson Publising Co*, Oxford, UK

[Aisher 1996] Aisher Yuval (1996) Spinning the Web, A guide to serving information on the World Wide Web, *Springer*, New York, USA.

[Reynolds 1996] Reynolds C. et al, (1996). Using Javascript, *Que*, Indianapolis, Indiana, USA.

[Metaxaki 1997] Metaxaki-Kossionides, Ch. (1997). A design procedure for training in Web, *Web- Net '97 on the WWW, internet and intranet, AACE*, November 1-5, Toronto, CANADA, 699-700.

[Metaxaki 1998] Metaxaki-Kossionides, Ch. et al, (1998). Using the Web to Study History, *Web-Net '98 on the WWW, internet and intranet, AACE*, November 7-12, Orlando, Florida, USA.

Using 3D For Electronic Commerce On The Web: A Psychological Perspective

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Abstract: We argue that the limited use of 3D technologies in e-commerce should not discourage designers from using these technologies. A review of empirical psychological work, supported by a model of consumer web behaviour, suggests that 3D environments will allow users to navigate intuitively if designers take care to provide suitable support (e.g. landmarks, maps). We describe recent work by the authors that found 3D environments led to greater retention of information, such as the location and identity of products within a store environment.

1. Introduction

The Internet is seeing the rapid development of different approaches to electronic commerce [Miles et.al., in press]. One class of approaches uses 3D-like virtual simulations of spatial real-world environments. [Richmond, 96] found subjects using a 3D VRML (Virtual Reality Markup Language) web site spent more money on average than subjects using 4 comparable hypermedia interfaces. Responses to Richmond's questionnaire found that the VRML subjects viewed the 3D interface very favourably, spent more time shopping in the VRML world, and under-estimated how much time they had spent. However, [Wickens & Baker, 95] argue that 3D environments might incur negative psychological effects, making 3D WWW sites harder to navigate than 2D sites. Our purpose here is to try and identify the qualities of 3D environments that might make them suitable for the WWW, focusing on electronic commerce (e-commerce) applications. Whilst many advantages of 3D worlds may emerge from their novelty value at present, there are more intrinsically valid reasons for using 3D. We draw on work carried out recently by the authors and our colleagues to identify advantages of using 3D on web sites. These advantages derive from the inherent psychological properties of three-dimensional environments, many of which have been explored experimentally. Our paper has three principal sections:

The first provides a basic psychological model of e-commerce user's behaviour,

the second section argues that 3D environments can ease navigation problems on complex web sites; the last section suggests that 3D environments provide excellent support for general learning about a web space and its contents.

Although our conclusions are specific to e-commerce user's of the web, it is our belief that these conclusions can be generalised to other web uses, e.g. information retrieval.

To begin with we will take a brief look at an existing 3D e-commerce site. SuperCity's 3D shopping mall is primarily a collection of Internet stores presented using VRML. Most of these stores are actually conventional hypermedia stores, though the Legal and General store is an example of a store where the VRML environment is carried through into the shop itself.

VRML is the dominant 3D technology used on the web today. The technology is based on a vector graphic engine with advanced features such as texture mapping, gourard shading, mapping of movies, animation and interactive controls. A contrast is the photo-realism of Apple's QuickTime Virtual Reality (QTVR) and Livepicture (www.livepicture.com). Although this has been used to help visualise products (e.g. BMW) and as a novelty feature (e.g. Wine Cellar U.K.), the more general use of QTVR on the web has been limited, perhaps by file sizes.

In this paper we concentrate on the use of 3D in e-commerce environments, primarily business-to-consumer situations. It is anticipated that many of our observations will generalise to other applications on the WWW. Long download times have been a major reason for not using 3D environments for commercial applications. However with compression of 3D files becoming more efficient and the bandwidth of the Internet generally increasing it may now be time for Internet sellers to consider 3D. Here we explain some of the the costs and benefits of such a move from a psychological perspective. The starting point for our analysis is a model of e-commerce consumer.

2. A Model Of Consumer Behaviour On The WWW

The processes required for completing an electronic commerce transaction are complex. [Guttman et. al., 98] have articulated a model of consumer buying behaviour. In there model are six stages: Need identification (the buyer identifies the need for a product or service); product brokering (the buyer identifies a range of products to satisfy the need); merchant brokering (the buyer determines who to buy from); negotiation (the terms of the transaction are determined); purchase and delivery; and service and evaluation. These stages offer a broad scope model of the entire purchasing process, in contrast, [Miles et. al., in press] choose to focus on the early stages of product and merchant brokering. They identify three principal categories of behaviour found in a user browsing commercial web pages: Criteria management, Search and Comparison. Briefly;

criteria management describes behaviours that determine what product a buyer will be looking for, including search for more information on a product's features and alternative options;

search behaviours involve navigation of the web in an attempt to find products that meet these criteria;

comparison involves the evaluation and contrasting of information about products that meet the target criteria.

Three-dimensional environments serve these user behaviours in a variety of ways. Below we focus on two ways that 3D environments can provide extra value to e-commerce environments. Section 3 explores a broad range of psychological issues that emerge when designing highly navigable 3D environments that facilitate *search*. Section 4 looks at how the information richness of 3D environments can help the seller provide information to the buyer that can potentially influence *the criteria management* and *comparison* activities in our user model.

3. Navigation In 3D Worlds

The problems of navigating hypermedia environments, such as the World-Wide Web, are well known (e.g. [Conklin, 87]; [Kim & Hurtle, 95]). We argue here that 3D environments are a potential means of easing navigation problems at complex e-commerce sites (and presumably other complex sites).

3.1 Knowledge About Real World Navigation

Work from real world navigation has found evidence for three distinct types of spatial knowledge about environments: Landmark, route, and survey knowledge [Thorndyke & Hayes-Roth, 82]. Landmark knowledge is centred on salient features of a 3D world. It is known that people encode knowledge of object locations in terms of their positions relative to such landmarks. Whilst this landmark-based knowledge may contain information about routes from this location, a more task-based form of knowledge is route knowledge. This can be considered a series of directions from one location to another. The most comprehensive form of information is that provided by survey-type knowledge. This is essentially a location- and route-independent cognitive map of an environment. It is a form of mental model and should allow rapid access to the information it contains irrespective of where the person is.

3.2 Making Navigation Easier: Where Do Current Technologies Fit In?

Disorientation in hypermedia environments is a well known problem and is a likely reason why e-commerce sites might fail. Those who have suggested VR has a very limited place in e-commerce and other web applications. [Wann & MonWilliams, 96] point to increased difficulty in navigating and using VR environments as a reason. However research has demonstrated a number of methods for reducing disorientation in VR environments.

[Ruddle et. al., 97]'s Experiment 1 looked at people's ability to navigate large-scale VR environments using a non-immersive interface. They found that after extended experience in an environment that users navigated the environment with ease, doing as well as subjects in [Thorndyke & Hayes-Roth's, 82] study of people navigating real buildings. More evidence for the navigability of VR environments is provided by [Howes et. al., 98] who found that in a series of product finding tasks in QTVR environments that subjects took more direct routes to target products when using a VR interface than when using a Hypermedia interface. [Howes et. al., 98] point out that one of the advantages of VR navigation is the vista provided of distant locations. The effects of seeing small images of the content of distant locations (the vista) may be similar to the effect of fish-eye views in hypermedia (e.g. [Schaffer et. al., 96]) where nearby nodes can also be seen. VR interfaces are likely to be more intuitive than fish-eye interfaces however (as the latter have no real world analogue).

There are many characteristics of VR systems that can be changed in order to increase the ease of navigation. [Ruddle, 98] lists 12. These include display type (e.g. immersive/non-immersive), size of the environment, graphic detail level, use of sound, movement constraints (e.g. walls), field of view and movement dimensions (e.g. many VR environments are based on 2D layouts). Below we focus on a number of other considerations that those designing VR-based web sites might want to consider.

3.3 The Use Of Landmarks

It seems that the shape, size and familiarity of landmarks is an important determinant of how useful they are. [Ruddle et. al., 97] found that landmarks did not help navigation in a VR world when the landmark was a rectangular block with a unique pattern on it, but did facilitate navigation when the landmark was an object familiar to the subjects on top of an unpatterned rectangular block. When these familiar objects were used subjects took more direct routes to target items, shifted their strategies to use the objects, but did not develop better survey knowledge. Whilst the Ruddle et. al. study used local landmarks only visible from the vicinity of the landmark, other VR studies have looked at the effects of global landmarks (e.g. such as a sun) that are visible from anywhere in the VR environment (although walls and other objects may potentially obscure the landmark). Studies of global landmarks by [Darken & Sibert, 93, 96] and [Tlauka & Wilson, 94] have found a strategy shifts toward using the landmarks, but have not reported better route knowledge (as evidenced by navigational efficiency) or survey-type knowledge (as evidenced by distance and direction estimates).

3.4 Orientation Aids

Whilst global landmarks might be considered a form of orientation aid (e.g. the sun in [Darken & Sibert, 93]) they can become obscured or just outside of the field of view. An orientation aid by contrast is independent of the environment and can be relied upon by the user as a constant. Although [Ruddle, 98] suggests that subjects felt more comfortable with a compass displayed as an overlay on the screen, he found no evidence for any significant route finding or survey knowledge differences when a subject had a compass, as compared to when there was no compass. An alternative to a compass that designers might consider is a map. The usefulness of a map appears more assured. [Ruddle, 98] compared five navigation conditions: without any aids, with a compass, with a local map, with a global map and with a global plus local map. They found that the map conditions all led to superior target finding than the compass and no-aids conditions. The local plus global map condition was in turn superior to the other map conditions. The global map provided by Ruddle showed a static image of the full environment with major landmark features marked but no target objects marked. The dynamic local map showed only the immediate locale but also showed any objects within that area. Orientation was indicated on both maps. The disadvantage of maps is of course the extra screen area needed to display them and the extra computational cost of updating a 2D map image as well as the main 3D screen (not a problem for static global maps however).

3.5 Adding Hyperlinks To 3D Environments

Ten attributes of hyperlinks in a 3D environment are listed by [Ruddle et. al., 98b]. They characterise the possible values on each dimension by their effect on usability, specifically the 'ease or speed of navigation'. Below we interpret these dimensions in terms of 3D environments used in commercial Internet roles.

Their first dimension is 'Integration'. This refers to the use of hyperlinks within a 3D environment. On one hand a 3D environment might have no hyperlinks at all. Alternatively there can be 3D 'islands' joined by hyperlink 'bridges', for instance in Supercity's shopping mall the 3D world of the mall is linked by a hyperlink with the 3D world of Legal and General shop, but movement is not possible using the 3D interface between the two (i.e. they are separate euclidean spaces). [Ruddle et. al., 98b] suggest a more navigable alternative is a large scale 3D 'hybrid' environment with districts that can be reached by hyperlinks or by motion through the 3D environment (i.e. the hyperlinks are between different locations in a single large 3D environment).

Other dimensions describe the '*Appearance*', '*Timing*', '*Directionality*', '*Rotational offset*' and '*Motion profile*' of a 3D hyperlink. [Ruddle et. al., 98b] argue that whilst a hyperlink can appear as a linked 3D object it is more desirable that the link appears either on a locality sensitive pop-up menu or (better still) in a constant 2D 'menu-bar' style lining to the 3D environment. They also argue that a short delay (2 or 3 seconds) associated with traversal of the hyperlink should reduce disorientation caused by instantaneous hyperlink traversals (see [Ruddle et. al., 98a], Experiments 1 and 2). More intuitively [Ruddle et. al., 98b] argue for bi-directional 3D hyperlinks (i.e. a 'back' button equivalent) and that when a hyperlink has been traversed the user should still be facing approximately the same direction. ([Howes et. al., 98] note problems associated with changes in orientation inherent in QTVR 2.0). The 'Motion profile' dimension is used to describe animations associated with the hyperlink jump.

Two of [Ruddle et. al.'s, 98b] dimensions describe the visual features of a hyperlink that help the user predict where the link goes and orient themselves once they get there. The '*Preview*' provided by a link provides information about where that link goes. In its simplest form the preview might just be a node title (e.g. 'Office products'). The '*Directional affordance*' of a link will also help the user in orienting themselves and constructing cognitive maps of the 3D space.

3.6 Experimental Data On Hyperlinks In 3D Environments

Discontinuity in spatial environments potential decreases the users ability to navigate [Ruddle et. al., 98a, 98b]. A hyperlink that jumps a user from one part of a 3D space to another is one sort of discontinuity. [Ruddle et. al., 98b] argue that discontinuity can be quite subtle, including slow updates to notionally continuous movement in a 3D environment. The effects of discontinuity are greater when there is no visual overlap between the screen before and after the discontinuity. For instance if the user is jumped from one side of a room to another, and remains facing the same way, then the screens before and after the jump will share common elements. However if the jump is from one room to another, with no 'window' between the rooms then there will be no elements visible in both the before and after screens. [Ruddle et. al., 98a] compared subjects jumping through hyperlinks, ghost doors and visually continuous doors. All subjects attempted to find objects in a large-scale virtual environment made of uniform square rooms. The hyperlink condition used hot-spots on a wall to allow a user to jump to the room behind that wall; the ghost door condition allowed subjects to move through the wall into the next room (importantly there was no visual continuity); the visually continuous doors subjects moved toward a door which opened as they approached allowing them to see into the next room (i.e. visual continuity is maintained). The Hyperlinks environment was found to be harder to navigate than the continuous movement environments. In Experiment 5 [Ruddle et. al., 98a] found that the visually continuous interface allowed better navigation than the ghost doors interface, even though both used the same method of movement and control.

3.7 Spatial Overlap In A 3D Web Space: Compressing Large Spaces Into A 'Tardis'

One problem that 3D environments have in presenting information is the space needed between nodes. Whilst small information structures might be easy to represent without asking the user to move too far in the 3D space, when large menu structures, typical of those found on many commercial web sites, then the distance between nodes is potentially very great. For instance a site with 10,000 products would need 10,000 different locations in the 3D space. The average Euclidian distance between any two products will be considerable. In contrast, using a menu structure, such as that on Quill's office products, catalogue only three links are needed to reach any of the thousands of products sold there. One solution to this problem is to use the same location many times. [Ruddle et. al., 98b] define this spatial overlap as a form of discontinuity in virtual environments. A classic example of such spatial overlap is the 'Tardis' telephone box in the old Doctor Who science fiction series, where the space inside the box appears much greater than the external dimensions of the box would appear to allow. Thus if you walked into the 'Tardis' and then walked a distance just greater than the external length of the box then you would be standing somewhere in the middle of the Tardis. This would be a different spot than if you had walked to the opposite-side around the external perimeter. The Euclidean co-ordinates would correspond but the physical location would not. Of course this is not possible in physical spaces, but it is in virtual spaces.

[Ruddle et. al., 98a] investigated the consequences on navigation of a 3D environment with 'severe spatial overlap' (Experiment 4). They found that participants initially made more navigation errors in the overlapping condition, but with a little practice this difference disappeared.

Imagine an overlapping 'shopping mall' with entrance doors to each store that are very close together but with large, Tardis-like interiors. The distance to any one shop is minimised. Once within a shop, the various departments are again made as close to the initial view-point as possible, using 'recursive' overlapping. As each department is entered it expands. Using an overlapping scheme, such as this, the complex three-level hierarchy at Quill's on-line catalogue can be navigated without the need to move large distances through the 3D space. The results provided by

[Ruddle et. al., 98a] suggest that with practice any decrement in a user's ability to navigate such a space may become negligible.

4. Learning About The Web Space In 3D Environments

As well as the buyers having goals that a seller should support, the seller will have a separate set of goals. These goals may sometimes conflict with the buyer's goals and an ideal e-commerce environment will allow seller's goals to be met whilst not infringing the buyer's behaviour. A principal advantage of 3D environments is the way that they allow seller's marketing goals to be met whilst not blocking buyer's navigation goals.

For example: The layout and arrangement of a large food store is a form of complex interface. Finding items is quite hard without the use of pre-existent knowledge about that store and that class of store layout. Whilst the navigational advantages of a real world store are important, perhaps their greatest advantage is their support for incidental encoding. By incidental encoding we mean learning about the environment whilst pursuing a specific goal. The goal specificity of human behaviour is well-documented [Anderson, 83] and items that are not involved in the critical path to a goal will often not be encoded. In real world environments people are able to engage in incidental browsing, noticing new items, desired items and well-priced items. Some of those who have experimented with home food shopping in the UK have reported that, as well as navigational problems, shoppers tend to buy fewer items than they would if they actually went to the shop (Sunday Times, October 98). Whilst this might empower the shopper and reduce the impact of unwanted marketing, it does seem that requiring the shopper to generate every item they need imposes a large memory load on the shopper (a large amount of cueing will occur in a typical shop environment). This may remove value from the Internet shopping experience when compared to real shopping. Of course the seller will want to bring other items they carry to the shoppers attention as well. It appears that the problem is in the flatness of the hypermedia environment and its graphical paucity. A 3D environment might be expected to allow the user to not only successfully navigate to the target item but also to learn about the environment they are in. [Thorndyke & Hayes-Roth, 82] established that people navigating real environments learn survey and landmark knowledge; by contrast those navigating menu like structures (and presumably hypertext) seem to acquire very little knowledge about the menus they use [Payne, 91].

[Howes et. al., 98] conducted a series of studies that contrasted a VR environment with a Hypertext environment. Howes et. al.'s choice for a VR environment was Apple's QTVR. The hypermedia comparison was made to text based tables containing the same product links as the VR environment, with the same number of nodes in each. The images used in all Howes et. al.'s Experiments were high resolution digital photographs. The use of photo-realistic images is a feature of QTVR, though VRML 2.0 has the potential to incorporate similarly high quality bit-maps.

Howes et. al. conducted 3 Experiments. The first used photographs of a real coffee shop, and the products it sold, as its navigable structure. There were four different locations in the VR coffee shop with 83 products, the majority of these located by category (this, of course, was true of the Hypermedia control as well). Subjects in the Experiment were asked to find 20 items from the coffee shop. The Experiment found that the VR subjects were able to generate many more novel items from this coffee shop than the Hypermedia control subjects. Novel items were those that the subject had not been asked to search for. However the VR subjects also took significantly longer to navigate the environment.

A second Experiment created a custom 'Garage sale' environment in order to control the presentation of the QTVR in more detail. There were just over 200 items in the Jumble Sale spread over 5 leaf nodes with 2 nodes used solely for navigation. Again the hypermedia control environment was a structural copy. Half the items were books, whilst the other half of the items were household objects. All these items were randomly distributed between the five leaf nodes. Again the subjects were asked to find target items (equal numbers of books and objects). In this environment VR and Hypermedia subjects showed no difference in the amount of time they spent completing the search tasks, but still the VR subjects were able to generate many more novel items than the Hypermedia subjects (markedly so, the VR group generated an average of 15 novel items, compared to 5 novel items from the Hypermedia controls). This generation data was also split by book and item with the finding that there was an interaction between item type and condition: VR subjects recalled many more objects but not book titles (though there was still a small advantage for the VR group on the latter). This is reminiscent of [Ruddle et. al.'s, 97] finding that only familiar objects rather than abstract patterns were useful as landmarks in VR navigation. This suggests that when people are looking for an item in a VR environment they learn about other useful landmarks, so long as the encoding of that landmark is easy (encoding a familiar object is easy). Hence when they navigate a 3D e-commerce environment they learn about items they are not looking for.

Howes et. al. leave open the reasons for why this is the case. The increased incidental learning in their QTVR environments may result from an evolutionary need to navigate real environments or perhaps be learnt from experience in complex modern environments. Whatever the detailed reasons, it does seem wise for designers of e-commerce sites to exploit this effect when designing sites where learning incidental information is useful.

Howes et. al.'s last Experiment used a VR analogue of a portion of the Quill on-line catalogue to look at the generality of the results from the other two Experiments. A further feature of the final Experiment was the use of a QTVR environment created using image processing software to paste product images into the 3D panorama. This effectively placed each item in a spatial location where that product had never been. Signposts helped the user find their way around Quill's flat menu structure. Again more novel objects were generated by the QTVR condition versus a Hypermedia condition (the latter was a version of the Quill on-line interface). The use of image processing software to create the environment for this final Experiment suggests that QTVR commerce sites, of the type described, might be created without the need to actually physically create a very large environment.

5. Conclusions

Here we have argued that 3D environments have a role to play in e-commerce. There is empirical evidence to support the view that 3D supports (a) navigation of complex web spaces, and (b) incidental acquisition of knowledge about the web space. Whether future technology will be sufficient to support fast 3D over an ever growing WWW is not at present clear, though recent developments in compression technology are encouraging.

References

Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Havard University Press.

Card, S.K., Mackinlay, J.D., & Shneiderman, B. (1999). *Readings in Information Visualisation: Using Vision to Think*. San Francisco: Morgan Kaufmann.

Conklin, J. (1987). Hypertext: An introduction and survey. *Computer, 20*, 17-41.

Darken, R. P., & Sibert, J. L. (1993). A toolset for navigation in virtual environments. In *Proceedings of ACM UIST '93* (pp. 157-165). New York: ACM.

Darken, R. P., & Sibert, J. L. (1996). Navigating large virtual spaces. *International Journal of Human-Computer Interaction*, 49-71.

Guttman, R.H., Moukas, A.G. & Maes, P. (1998) Agent-mediated electronic commerce: A survey. *Proceedings of the Workshop on Agent Mediated Electronic Trading* (AMET'98), Minneapolis, Minnesota.

Howes, A., Miles, G. E., Payne, S. J., Mitchell, C. D., & Davies, A. (1998). An experimental investigation of a sample 3D technology in a e-commerce setting. *Manuscript submitted for publication.*

Kim, H., & Hurtle, S. C. (1995). Spatial metaphors and disorientation in hypertext browsing. *Behaviour & Information Technology, 14*, 239-250.

Miles, G. E., Howes, A., & Davies, A. (in press). Understanding electronic commerce systems: A dimensional analysis of current technologies. *International Journal of Human Computer Studies.*

Payne, S. J. (1991). Display-based action at the user-interface. *International Journal of Man-Machine Studies, 35*, 275-289.

Richmond, A. (1996). Enticing online shoppers to buy: A human behaviour study. *Online proceedings of WWW5*, Paris, May 6-10 (http://www5conf.inria.fr/fich_html/papers/P50/Overview.html).

Ruddle, R. A. (1998). Experimental studies of navigation and spatial knowledge in "Desk-top" virtual environments. *Unpublished doctoral thesis.*

Ruddle, R. A., Howes, A., Payne, S. J., & Jones, D. M. (1998a). The effects of hyperlinks and spatial overlap on navigation in virtual environments. *Manuscript submitted for publication.*

Ruddle, R. A., Howes, A., Payne, S. J., & Jones, D. M. (1998b). Attributes of discontinuous virtual environments that affect navigation. *Manuscript submitted for publication.*

Ruddle, R. A., Payne, S. J., & Jones, D. M. (1997). Navigating buildings in "desk-top" virtual environments: Experimental investigations using extended navigational experience. *Journal of Experimental Psychology: Applied, 3*, 143-159.

Thorndyke, P. W., & Hayes-Roth, B. (1982). Differences in spatial knowledge acquired from maps and navigation. *Cognitive Psychology, 14*, 560-589.

Tlauka, M., & Wilson, P. N. (1994). The effects of landmarks on route-learning in a computer-simulated environment. *Journal of Environmental Psychology, 14*, 305-313.

Wann, J. & MonWilliams, M. (1996). What does virtual reality need?: Human factors issues in the design of three-dimensional computer environments. *International Journal of Human Computer Studies, 44*, 829-847.

Wickens, C., & Baker, P. (1995) Cognitive issues in virtual reality. In W. Barfield & T. Furness III (eds.) *Mental Models and Human-computer Interactiõn* (pp. 514-541). Oxford: Oxford University Press.

The Alliance+ Project: An Innovative Partnership to Promote Teacher Training on Internet's Use in the Curriculum

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Abstract: The background, partnerships, strategic decisions, and design features of the Alliance+ program are presented. Alliance+ brings a national community college organization, a career center, a technological university, educational research entities, community colleges from Cleveland, Miami and Phoenix, and the school systems from those cities together in a five year effort to provide technology-in-education training for 10,000 teachers.

The Challenges

Alliance+ was undertaken as a large-scale national teacher training model in the United States as a solution to two fundamental problems that confront educators worldwide, both of which must be solved with high quality programs at affordable cost:

1. The need to accomplish transfer of "best practices" from a small group of localized innovators to a larger national or global community of teachers; and

2. The task of providing ongoing support for these large numbers of teachers on the implementation of the "best practices" in a city, county or province.

These challenges are of critical importance for all educational innovations but are particularly severe for technology-based applications in pre-university settings. The vast majority of teachers are not prepared to quickly gain mastery over new artifacts and systems and to integrate those new technologies into classroom practice. Some of the hurdles that are uniquely associated with technology-based innovations include the following:

- Since technology is constantly changing, teachers are frequently challenged with mastering the intrinsic characteristics of the new technology itself. The time required for this can easily be one year.

- A teacher who masters a new technology must then explore how this technology can be used in classroom practice and as a tool to facilitate student learning. This period of exploration can take an additional year.

- Finally, a teacher who masters the new artifact or system and understands its pedagogical potential, must then create new classroom materials and strategies. In many cases the advantages inherent in the new technology are best exploited through project-oriented, student-centered activities. For most teachers, these modes of teaching are new and require acquisition of new skills and the development of new sensitivities, attitudes and methods of classroom practice. Coming to grips with these challenges and refining new approaches can require yet another year!

This three year developmental process has limitations—not all teachers have the vision and insight needed to independently create new approaches. For those who do, it is unlikely that they will be given the time and support needed for such extended curriculum development efforts. Even if they are successful, after three years there is a good chance that the technology itself will be replaced with something that is vastly superior.

Since Alliance+ is dealing with the Internet, the program must grapple with another, somewhat more subtle challenge. While most computer-based techniques can be categorized as "tools" for teachers or students, the Internet creates a new environment for learning that potentially encompasses all segments of society and all instrumentation that can be digitized. In dealing with the Internet, teachers are not merely learning techniques, they are entering into a new culture, new ways of learning, and new ways of communicating.

The cultural transformation inherent in this process engages teachers in continuous learning and adaptation. Introduction of Internet into schools requires more than participation in a finite number of workshops, but immersion into a community of users. There is no fixed time period for this process. Rather it will be ongoing. Since there is no end in sight for the development of Internet technology, there will be no end in sight for the adaptation process. It is critical that Internet-related training be structured to engage teachers in a stable supportive infrastructure.

With this perspective, we re-examine the original questions. Given a small cadre of early innovators who have gained insight, understanding, and experience with the new capabilities of Internet technology—how can this expertise be disseminated widely and how can large numbers of teachers in a given locale be provided with appropriate training and essential continuing support?

Partners & Philosophy

Alliance+ is a model for teacher professional development that reaches teachers who are thousands of miles apart, but which provides face-to-face workshops and support as well as tools, resources, and assistance through distance communications. To achieve its mission, Alliance+ unites the efforts of more than 35 state, local, and higher education partners who have been independently concerned about workforce development in general and teacher preparation in particular for a number of years.

The core members are the Center for Improved Engineering and Science Education (CIESE) at Stevens Institute of Technology (NJ); Polaris Career Center (OH); Cuyahoga (OH), Maricopa (AZ), and Miami-Dade (FL) Community Colleges; The League for Innovation in the Community College (CA); the public school systems in Miami, Phoenix and Cleveland; Educational Testing Service (NJ), and Bank Street College of Education (NY). Coupling these partners' diverse expertise in teacher professional development, curriculum development, computers-in-education innovation, project management, workforce training, and educational assessment, this five-year project aims at preparing 10,000 classroom teachers to integrate Internet technology into the curriculum, with a direct impact on over a quarter million children.

The question of how to use Internet most appropriately in instruction has been a constant concern for many of the project partners. We have worked collaboratively with teachers on the analysis of potential classroom applications. We also visited and consulted other programs throughout the United States. What we found was that many educators were relying on Internet applications that were essentially archival in nature. While the Internet is a vast library resource, we believe that its greatest potential lies in its interactivity and its ability to bring real-time data, particularly in science, into classrooms.

We, therefore, concentrated on accessing Internet-based curriculum resources that empower students at all age levels to "do" science instead of hearing about science and to otherwise pursue constructivist learning experiences. Some of the materials can be examined at web sites at CIESE and at Polaris (www.ciese.org and www.polaris.edu/iltli). CIESE has also published articles that describe the approach (e.g., "Web Adventures in K-12 Science," *Technos*, Vol. 6 No. 4, Winter 1997).

As we worked through some of our earlier, independent projects, we realized that we had acquired expertise that was not widespread. To gain perspective, we remind ourselves that the Netscape Company was incorporated in November of 1994. As we speak at AACE '99, Netscape has been a product for less than five years! Yet graphical user Web browsers are now used by scores of millions of people worldwide. The challenge for Alliance+ members as we approached this project was how might we share our experience with distant teachers and school systems.

Rationale for the Model's Design

In our cumulative experience, many inexperienced teachers encountering applications of new technologies profit more from face-to-face workshops than from distance learning. Many such novice users require an initial level of personal attention from an individual or a group with whom they can consult in an ongoing fashion. Once relationships have been established and technology hurdles have been crossed, the option of online instruction and support is more attractive and effective.

In designing this model, one learning option we considered was interactive video. In past years CIESE produced more than 30 hours of satellite video broadcasts on applications of software in mathematics education to teachers throughout the United States. While these programs included documentary television segments of real classroom experience as well as discussion sessions, teachers were quite clear in requesting face-to-face hands-on workshops as an essential learning experience.

Another option was online instruction. Several Alliance+ partners have significant backgrounds in online instruction. These experiences have revealed that while large numbers of teachers participate in and profit from online courses, many teachers need more direct and personal learning experiences that involve mastery of hardware and software in locations where they can interact with others and receive assistance in working directly with materials that are being presented in their courses. The efficacy of online instruction for teaching new technology applications is routinely debated within the Alliance+ group, but the consensus is that online instruction will play a larger role in the next several years of the project.

In some cases, school systems themselves will be able to provide the required instruction and support. However, many school systems in the U. S. are too small to be able to grapple effectively with challenges of technology-in-education. In addition, many large school systems are either too bureaucratic or too bogged down with social and behavioral problems to be successful in this arena. State agencies could help meet this need, but have not addressed these issues. Alliance+ partners feel that the most effective strategy is to manage the needed educational programs via the nation's strong cadre of higher education institutions and other demonstrably effective organizations.

In the Alliance+ approach, materials are produced and organized for national distribution at a technically-sophisticated research university and then implemented at regional resource centers. Project partners share a strong commitment to producing curriculum and training materials through close collaboration between higher education developers and teachers and schools. All materials are tested and proven effective through use in classrooms.

An added strength of the Alliance+ design stems from the fact that the higher education institutions involved in developing materials, especially those with engineering and computer science departments, are close to the evolution of technology itself. These institutions are optimally positioned to anticipate and respond to constantly evolving technology.

The Key Role for Community Colleges

The United States has an extraordinary opportunity to develop regional resources centers for teacher professional development in applications of technology in instruction at regionally located community colleges. Approximately 1,000 community colleges exist in the United States, with approximately one institution within commuting distance of 90 percent of the American population. These colleges provide two years of postsecondary education as well as many continuing education courses and special education programs for adults.

More than one-half of all students enrolled in post secondary education in America today are attending community colleges. Some students are enrolled in transition programs that will prepare them to enter the third year of a four-year college program, and some are enrolled in terminal one- or two-year programs for certificates or associate degrees in fields such as engineering technology, medical technology, and culinary arts, among others.

The Alliance+ approach relies on community colleges as the local nexus in a train-the-trainer model, in which the CIESE group at Stevens Institute of Technology trains faculty and staff at community colleges who, in turn, provide continuing education and follow-up support for teachers in school systems in their region. Some of the advantages of this system of using community colleges as regional training centers include the following:

- Community colleges are more teaching-oriented than four-year schools, which usually place higher priority on faculty research and publication records than on teaching.

- Community colleges are focused on supporting their immediate geographical region. They are usually funded to provide education for individuals in a particular region and are seriously committed to this pursuit.

- Because they are organized by region, with no competitor within in their own region, they are more likely to collaborate with other institutions since they are free of rivalries.

- Community colleges in the United States have many programs to help students in secondary school make the academic transition to higher education. They are familiar with the secondary school curriculum and provide remedial courses and review courses, as well as advanced placement and dual enrollment courses for secondary students. Through programs of this sort, many community colleges have established working relationships with local school systems and have become familiar with their culture and mores.

- Community colleges also engage in education that is highly focused on the workplace and have strong sensitivity to the needs of working professionals. Community colleges have vast experience with continuing education of adult learners and have also implemented extensive programs of workplace training through direct contracts with corporations and government agencies.

Given these factors, it is surprising that community colleges have not been more active in providing continuing education for teachers. Perhaps they have been standing aside from that market in deference to colleges of teacher education. But experience shows that colleges of teacher education in the U. S. are generally not eager to undertake such field-centered programs. This is especially true in the domain of technology where many of the colleges of teacher education have not yet become proficient themselves. In contrast, in many cases, community colleges are leaders in the use of technology in their academic and outreach programs and poised with potential to meet the critical ongoing teacher development need in this nation.

Alliance+ Organization

At the center of Alliance+ curriculum and project development is the Center for Improved Engineering and Science Education (CIESE) at Stevens Institute of Technology. Stevens is a small private technological university founded in New Jersey in 1870 on the left bank of the Hudson River across from mid-Manhattan in New York City. While Stevens does not have teacher education programs, for more than 20 years it has been an innovator in applications of computers and information technology in the education of scientists and engineers. For more than a decade the CIESE group has been providing training programs for teachers and outreach assistance to school systems on applications of computers and networks in teaching mathematics and science in elementary, middle and high school programs.

A crucial aspect of this model is the high level of partnership and collaboration by the League for Innovation in the Community College. The League is the premier organization in the United States devoted to creation and dissemination of new programs that strengthen the role of community colleges as centers of educational and training services to meet local needs. The three community colleges participating in the project are included among the 20 institutions that hold full membership in the League, and are considered national models for technology implementation and building relationships with local communities and schools. Not only is participation of the three community colleges in Alliance+ coordinated by the League, but the League is in a strategic position to bring knowledge of this project to the full cadre of community colleges located throughout the United States. While Alliance+ was not organized to be an international project, it is also the case that the League is actively working with educational organizations on a global scale through its members in Canada, Guam, the U.K., The Netherlands, and Australia.

Although materials development and dissemination are centered in higher education institutions, Alliance+ is fundamentally a school system project. A key school leadership role in the project is held by the Polaris Career

Center, a regional vocational-technical school district in Middleburg Heights, Ohio, which has as its mission workforce development. To this end, the Instruction, Learning and Technology Leadership Institute (ILTLI) was developed at Polaris to provide professional development to prepare teachers to more effectively use technology in schools. The ILTLI focuses on improving the technical and pedagogical skills of teachers by helping them understand not only the technology but the ramifications it has on teachers behavior, knowledge construction, deepening student understanding of concepts, and providing a more authentic means of student assessment. Polaris functions nationally in overall Alliance+ project leadership, as well as in local teacher training and project implementation in the Cleveland area.

Liaison with school districts in all three implementation sites is maintained by the community colleges in each region, and implementation is pursued jointly with the leadership of the school systems in each of the participating metropolitan areas. The level of school system commitment to Alliance+ is demonstrated in financial contributions that they have made to this program. The five year award from the U. S. Department of Education for this Technology Innovation Challenge Grant (Grant #R303A980063) is $9.3 million. Funds allocated by the partners toward the program total $11.8 million of which $9.6 million is from the participating school systems. These school systems are expending resources to cover the costs for teacher participation in the program, as well as costs for their own staff who will serve as mentor teachers and program administrators. These figures demonstrate a tangible commitment to a program that is highly valued by the participating school systems in Arizona, Florida and Ohio. In each case, educational leaders in those states report that Alliance+ is providing vital training that brings applications of technology together with curriculum innovations and that such training and assistance is not available locally.

The specific implementation model establishes a team of core trainers at each community college site. The core trainers are either community college faculty or staff. These core team members are trained directly by CIESE staff. The core trainers in turn train lead teachers at school systems who are designated as mentor trainers. It is the mentor trainers who then provide workshops for the teachers in the school systems. The training sequence is summarized in the following flow chart: Stevens Institute Team → Core Trainers → Mentor Trainers → Teacher Trainees

Implementation is taking place at three Alliance+ sites simultaneously. We obtain a factor of approximately 10 in human resources in each transition. For example, Stevens trains 10 Core Trainers in an intensive face-to-face week of sessions; these 10 core trainers then train 100 mentor trainers, who in turn reach at least 1,000 teachers. The exact timing, scheduling and organization of these sessions vary from site to site. While this is a national program, the implementation is orchestrated and implemented locally.

Community college partners include Cuyahoga Community College in Cleveland, Ohio, Maricopa Community College in Phoenix, Arizona, and Miami-Dade Community College in Miami, Florida. The three locations were purposefully chosen to have partners separated by large distances as a context for a meaningful test of a model that could be applicable on a national scale. Cleveland lies 675 kilometers to the west of Stevens, while Phoenix is 3,500 kilometers to the southwest and Miami is 1125 kilometers to the south.

Another significant reason for the selection of these three locations for inclusion in Alliance+ is their level of need. Each of the three metropolitan areas is categorized as economically disadvantaged by federal criteria. In addition there are large numbers of families whose children in these schools are recent immigrants without a firm base in the United States and lacking knowledge of the English language. Phoenix has a large Mexican American population and Miami has many families from Central and South America.

The educational problems in the school systems are severe. Control of the Cleveland Municipal schools has recently been transferred to the mayor in a dramatic reorganization effort. The Miami-Dade Public Schools, the fourth largest in the United States, has an enrollment of about 350,000 students and is grappling with growth in student population of 10,000 per year. Phoenix is currently the fastest growing city in the U.S., and currently the city cannot build schools quickly enough to keep up with population expansion. In addition, all three sites are highly multicultural and rich with political histories, thus educational development programs in these cities must take place with full cognizance of and sensitivity to cultural, social and political realities. Community colleges provide a viable base for success in dealing with these issues.

Alliance+ Materials and Systems

The goal of the program is to train at least 10,000 teachers in a 30-hour course on the use of Internet in science education in a five-year period. A concomitant goal is to engage teachers in a community of educators that will sustain and develop professional practice with Internet-based education. Kindergarten through 12th grade teacher preparation is being addressed through three separate curricula: elementary, middle school and high school.

The 30 hours of hands-on workshops are divided into 10 three hour sessions with the overall instructional program known as the *Savvy Cyber Teacher*™ (SCT) series. SCT introduces teachers to the functionality of the Internet and its use in instruction in unique and compelling applications. SCT stresses real-time interactivity, acquisition of real-time data and opportunities for students of all ages to engage in the scientific process. [The outline for SCT and examples of curriculum applications can be reviewed at the CIESE Web site: http://www.k12science.org by clicking on "Alliance" to examine project information and on "Curriculum" to examine Internet-based learning materials.]

SCT provides teaching techniques on using email to bring expert advice into classrooms, knowledge of systematic approaches to web search, the development of web pages and classroom management techniques for one computer or many computer facilities. In addition, SCT offers real-time data projects, such as the Stowaway Adventure (http://k12science.stevens-tech.edu/curriculum/oceans/cyberstowaway.html), in which middle school children track the progress of merchant ships located in any of the world's oceans. Acting as virtual "stowaways," these students use mathematics to calculate velocity and geometry to track the ship's voyage and plan their arrival at a safe haven.

In addition to engaging teachers in hands-on experience, Alliance+ provides follow up visits to the schools and discussions with mentors and trainees on their experience with these techniques. Alliance+ also brings community college and school system administrators together in joint efforts to achieve educational improvement. The CIESE group at Stevens interacts with the core trainers and mentor trainers on a regular basis using email, listservs, visits, videoconferences and periodic face-to-face meetings of the key participants from the three sites. Listservs, email, and telephone assistance from core and mentor trainers provide classroom teachers with assistance and support.

Online feedback is obtained as teachers attend each training session. The feedback details their experience in each session. Also, a comprehensive online database is maintained known as the DataFeed System. This system provides information on the identification of participants, time, and location of all workshop sessions.

During the second year of Alliance+, Bank Street College of Education in New York City will work with other partners of Alliance+ to create pre-service materials (for university students preparing to become teachers) based upon the three versions of SCT.

The progress of Alliance+ and its impact on teachers, their school systems and ultimately students is being monitored by researchers from Educational Testing Service in Princeton, New Jersey. In addition to questions of efficacy, the project is being studied to evaluate the viability of the organizational model and its potential for replicability in other locales.

As this five-year program evolves, we feel certain that it will undergo significant changes as teachers become more adept in the use of the technology and as the technology itself undergoes change. At this stage, we see great enthusiasm for introduction of these approaches into classroom practice. We have high expectations for the evolution of exciting new educational environments in the coming years and look forward to contributing to the cultural transformation taking place in education as teachers embrace new ways of teaching and learning.

Acknowledgements:

No Time to Kill: Entrainment and Accelerating Courseware Development

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Abstract: This paper examines the concept of time in multimedia, web-based courseware development. The biological concept of entrainment as extended to social psychology reveals four components of entrainment that could be valuable in accelerating courseware development: rhythm, mesh, tempo, and pace.

1. Introduction

The phrase, "I'll be *right* back," is literally translated into Chinese as, "I'll be back *on a horse*." If necessary as a face-saving gesture, a slow return may politely be attributed to a slow horse. Although "right back" and "back on a horse" are temporally ambiguous, both phrases are extremely meaningful in context. [Hall 83 p. 13] explained "...that there are as many different kinds of time as there are human beings on this earth... ." The western concept of time as even time, chronological time, or clock time has evolved over the ages [Bluedorn & Denhardt 88]. Time-keeping was originally based on events, such as planting or harvesting, but as Marx's writings on the "commodization" of labor resulted in treating labor (and laborers) as commodities, time eventually emerged as an equation, "time is money." [Bluedorn & Denhardt 88] point out that most organizations are likely to experience some natural tension between even time and event time (linear and cyclical); however, the "time is money" equation is a factor in courseware development. Some experts estimate more than 100 hours of development time to develop a single contact hour of multimedia instruction. Certainly courseware developers have been caught bringing their courses to market "on a slow horse" and are looking for ways to speed products to market.

This paper explores the application of entrainment (the alignment of rhythms within and between systems) to accelerate courseware development. Certain parallels are drawn from new product development in industry to courseware development. The discussion begins with the foundational concepts of entrainment, from biological systems and social psychology. Second, examples of entrainment in courseware development are presented and discussed, including illustrations of rhythm, mesh, tempo, and pace. Concluding remarks are then offered.

2. Entrainment

2.1 Biological Entrainment

The concept of entrainment first developed as scientists observed rhythms in physiological systems that seemed to be synchronized in terms of period, amplitude, and phase [Brown 82]. Both physiological and behavioral events, or systems of events, were found to be *entrained*, or synchronized internally to each other, as well as entrained to pacers in the external environment.

A system is not modified when entrained, but its phase and periodicity is captured by a pacer or *zeitgeber* (German: time + giver). The biological cycles exist at multiple levels (molecule, cell, system, and organism) and within various temporal orders, ranging from months and years to milliseconds [Rose 88].

Cardiorespiratory rhythmicity is an example of the complexity of mutual entrainment of the rhythms manifest by both the respiratory and cardiovascular systems to each other and to external pacers [Koepchen 90]. The two systems are coupled to each other peripherally as well as centrally to transport oxygen to cells and carbon dioxide from cells. Since the transport demand can change by a factor of more than twenty to meet metabolic needs, the systems must adapt to actual behavioral activity from moment to moment--even though the system rhythms have different drivers. The circulation driver originates in the periphery, whereas the respiration driver originates in the central nervous system. Adding to the complexity of entrainment is the evidence that the heart's pacemaker is modified by central nervous influences which interfere with the central respiratory rhythm generator. [Koepchen p. 16] concludes that the rhythms present in every function interact with each other in a variable manner without a fixed relation of cause and effect: "One rhythm can lead, entrain, or influence the other in a more or less strong way." Self-organization results in a rhythmic order that "enslaves" the individual elements.

In addition to mutual, internal entrainment, biologists have identified strong external pacers to which systems become entrained. Probably the single most commonly observed entrainment phenomenon is human entrainment of *circadian* (Latin: about + a day) cycles to the light-dark cycle resulting from the earth's solar orbit. For example, humans have an elaborate temperature regulatory system to regulate body temperature regardless of ambient temperature, but it also fluctuates cyclically in a circadian rhythm (low temperatures at night from 3 to 5 a.m.), synchronized with overall activity levels which are also circadian in nature [Wilkinson 82]. *Ultradian* (Latin: within + a day) rhythms also appear in activities such as eating, respiration, metabolism, work-rest cycles, etc. When the external pacer (the 24-hour light-dark cycle) shifts, as may be the case after transmeridian flights, the entrained rhythms become desynchronized to the external zeitgeber as well as losing their mutual entrainment with individual systems. The result is "jet lag" (transmeridian desynchronization) manifested in a variety of psychophysiological maladies, including gastrointestinal distress, loss of appetite, insomnia, headaches, irritability, dizziness, and a general feeling of weakness and fatigue [Graeber 82]. It is hypothesized that circadian rhythms are allowed "free run" during flight and spontaneously deviate from an exacting 24-hour clock. When again exposed to naturally occurring geophysical and social time cues, the circadian rhythms regain their 24-hour periodicity. The discomfort and behavioral impairment from jet lag is a direct result of a series of events: first, the systems become decoupled from the external pacer, resulting in external desynchronization (*i.e.*, lag if going east); second, the systems become decoupled from each other, destroying mutual entrainment and resulting in internal desynchronization; and third, the systems readjust at different rates [Aschoff *et al.* 75].

As can be seen from the foregoing examples, biological and behavioral entrainment is a central concept for human well-being. Both mutual entrainment of individual systems and entrainment to environmental zeitgebers are essential for sustaining life.

2.2 Social Entrainment

Extension of the concept of biological entrainment to social entrainment has taken place over the last twenty five-years. It has been identified at the individual, group, and societal levels [Condon 78] [McGrath & Kelly 86] [Hall 83].

[McGrath & Kelly 86] used entrainment concepts to develop a model explaining the social psychology of time and to explore entrainment of behavior in social and organizational settings. They observed that, similar to the biological model, systems or patterns of behavior can be mutually entrained, as well as entrained to external pacers or entraining cycles (zeitgebers).

[McGrath, *et al.* 84] found human behavior at the social psychological level to be mutually entrained to arbitrary, but powerful, external cycles such as work schedules, the standard cultural definitions of the seasons, social definitions of day and night, etc. Assigning groups different time periods to complete the same problem-solving tasks, McGrath *et al.* found that the work expanded to fit the available time [Parkinson 57], as well as the converse, work contracts to fill the time available. Interestingly, when observing work in temporally altered subsequent time periods, they found that groups continued to work at the initial pace. McGrath *et al.* concluded that the groups entrained to the initial pace (whether fast or slow) and had difficulty changing their pace.

Other patterns involving social entrainment have been observed, but with slightly different group dynamics. Gersick [1988] observed a pattern of punctuated equilibrium in group work: at the approximate mid-point of the time constraint, groups appeared to go through some type of crisis, changed their problem-solving strategy, and paced themselves for the second half of the time period. In entrainment terms, it appears that the group became desynchronized at midpoint after evaluating its progress, after which the group re-entrained to a new pace (only half of the time left).

Although much research is needed in this area, it appears that individuals in groups experienced mutual entrainment, as well as the group being entrained to an initial external pacer. [McGrath & Kelly 86] constructed a model of social entrainment consisting of the following four components:

- RHYTHM: multiple endogenous temporal or rhythmic processes or patterns
- MESH: mutual entrainment or synchronization of rhythms
- TEMPO: temporal patterns expressed in actual behavior resulting from synchronization of rhythms
- PACE: external pacer events or entraining cycles affecting rhythm, mesh, and tempo

Differing slightly from the biological model, which emphasizes the "capture" of rhythms by external pacers, the social model of entrainment seems to allow a little more participant discretion.

3. Entrainment in courseware development

Similar to the rhythms of various functional systems studied by biologists and social interaction patterns studied by social psychologists, different rhythms in courseware development exist, including those manifest by the assorted functional groups engaged in new product development such as engineering, manufacturing, marketing, and executives. The various rhythms or patterns of the groups have the potential to be mutually entrained (meshed). For example, in multi-functional development teams, the team members mesh their individual functional rhythms; or the team meshes its own rhythm and patterns with consumer patterns and cycles. Internal and external pacers also play a role in examples of entrainment observed in courseware development. Internal project phase review cycles and external regulatory agency cycles tend to capture the courseware development cycle, resulting in a distinctive tempo associated with development. With an eye to better understanding the principles that determine the tempo of courseware development, this section discusses manifestations of entrainment in development in terms of rhythm, mesh, and tempo.

3.1 Rhythms in Courseware Development

There are a number of rhythms (multiple, endogenous, temporal, or rhythmic patterns or cycles) observable in new product development in general, both internal and external to the organization. Examples of rhythms within the organization are presented first, followed by examples of rhythms external to the organization, concluding with formal propositions.

The assertion made by [Berger & Luckman 66] that time is a social construction varying between and within societies can be extended to the sub-societies involved in courseware development. For example, [Gurvitch 64] concluded that different classes or groups within cultures move with different rhythms and with different temporal perspectives. Within the organization, different rhythms or patterns (systematic differences in goal orientations, time frames, norms, and shared coding or language schemes) have been associated with organizational differentiation [Lawrence & Lorsch 67] [Thompson 67]. Furthermore, individuals establish unique organizational role identities through socialization into organizations [Katz 88]. The socialization process also includes learning how to deal with one's boss and co-workers, as well as deciphering reward systems and situational norms. Newcomers are taught, "This is how we do it here," whether it be a company such as Microsoft or General Electric, or a functional group such as engineering, manufacturing, or marketing.

Functional groups operate with certain natural or man-made rhythms, patterns, or cycles. For example, in manufacturing, progressive companies are now tracking inventory turns, quality metrics, slashes in set-up time, and throughput time reductions, rather than labor efficiency and machine utilization [Schmenner 88]. Resulting manufacturing cell (group technology) concepts, u-shaped lines, and multi-model lines yield greatly improved productivity, flexibility, space utilization, and quality. This type of rhythm within manufacturing requires cooperation from the natural rhythms of traditional factory departments or kingdoms, such as: equipment, layout, quality, materials handling, production planning, inventory control, and cost accounting.

Certain rhythms or patterns have been observed in R&D work. Examples include the S-curve phenomenon observed in comparing technical performance with research effort over time [Foster 86]; learning and unlearning [Imai *et al.* 85]; patterns of communication [Katz 82]; fluid, transitional, and specific patterns of innovation [Abernathy & Utterback 88]; and the rhythm of product introduction and retirement [Von Braun 90]. Certain patterns have been identified in groups that accelerate new product development that probably apply to courseware development, namely those patterns associated with critical roles played by group members such as product champion, gatekeeper, and technical experts [Smith & Reinertsen 91].

The external environment of the organization manifests certain rhythms or patterns. [Tushman & Romanelli 85] identified patterns of alternating periods of inertia and revolution experienced by organizations. Technological, legal, regulatory, and/or market discontinuities occur to disrupt periods of inertia, requiring adaptation. These external rhythms play out in the web arena in terms of technological discontinuities and uncertain regulation.

Examples of patterns or rhythms internal and external to the organization such as those mentioned above appear to play a role in the speed of courseware development. To understand the implications of their existence, particularly in connection with accelerating new courseware development, it is necessary to examine how these patterns or rhythms mutually entrain or are entrained to other pacers.

3.2 Mesh in Courseware Development

Mesh is the synchronizing or mutual entrainment of different rhythms or patterns involved in courseware development. One of the most frequent techniques for accelerating product development that applies to courseware development is to employ cross-functional teams [Rosenau 92]. Cooperation and coordination of these teams (graphics, audio, video, instructional design, programming, user-interface, etc.) is critical to success. Specific findings in industry studies have led to counsel such as the following: secure early involvement of functional groups [Gupta & Wilemon 90]; use small, self-managing, multi-functional project teams [Takeuchi & Nonaka 86]; allow "sign-up" for teams rather than edict [Gupta & Wilemon 90].

In addition to functional diversity requirements, satisfying other team criteria has also been recommended to accelerate courseware development. Suggestions include limiting teams to ten or fewer members, having members serve on the team from conception to production, making full-time assignments to a team, having members report directly to the team leader, and physically locating the team within conversational distance of each other [Smith & Reinertsen 91].

Although there seems to be agreement on the effectiveness of multi-functional teams in accelerating new product development, some dissension exists. A recent empirical study examining new product development teams concluded that the overall effect of diversity (functional and tenure) on teams actually impeded performance [Ancona & Caldwell 92]. Even though diversity brought more creativity to problem solving and product development, the diverse team was less capable of teamwork than a homogenous team. Functional diversity was found to facilitate increased communication outside the team's boundaries--to the possible detriment of internal communication. Based on field interviews and a mail survey of managers and technologists involved in development, [Gupta & Wilemon 90] identified four ways functional groups delay the product development process: failure to give product development program priority, continually changing requirements, poor intergroup relations, and slow response time. [Stalk & Hout 90] also found that functional support groups could delay or "gate" the key sequence of activities for product development by forcing key activities to wait in queues for execution, delaying other key resources.

From the above, it appears that multi-functional groups can accelerate courseware development, but researchers are beginning to identify some contingencies. [Bower & Hout 88] argue that the concept of accelerating development through multi-functional teamwork must be extended to the entire organization or company, building a strategic "fast-cycle capability." Otherwise, the teams become special task forces or "skunk works," which cannot provide a sustainable, competitive advantage in the long run. Fast-cycle capability requires mutual entrainment of functions. Only when multi-functional team members synchronize their functional rhythms to a new, appropriate "team rhythm" can time be reduced in new product development. From a broader perspective, Jack Welch, the CEO of General Electric, insists that best practices of any of his businesses (going beyond functional groups) be transferred "across all the businesses, with lightning speed" [Tichy & Charan 89:115].

Besides the mutual entrainment or mesh of internal functions and cycles, entraining to external rhythms and patterns, such as students, teachers, development tools, technological advances made in the web environment, is also critical. [Clark & Fujimoto 90] assert that the single most important task for product development is external integration: "matching the philosophy and details of product design to the expectations of target customers (p. 112)." Courseware developers could benefit from strategies employed by companies who have been forced to integrate customers and suppliers into the new product development process. Courseware developers face similar external challenges with a shift to a less stable market, shorter course life cycles, and teacher/student preoccupation with technical performance. Even though structural mechanisms (such as multi-functional teams) speed problem solving and improve the quality of solutions and create fresh, technologically advanced products, they fall short if the product concept fails to anticipate future needs and wants.

Timing is also a key factor when considering meshing mutually entrained functions to technological rhythms. For example, the timing or release of certain development tools or compression techniques certainly influence courseware development.

Another thread in a mesh designed for decreasing product development time is to connect with external sources for product innovations. Courseware developers could license or buy advances achieved by others, buy courses that have achieved the desired advances, and use independent contractors with specific R&D skills needed. Courseware developers must be able to recognize patterns and advances in the environment and determine the fit with new course development.

As discussed above, the types of meshing, or synchronizing of rhythms and patterns manifest in courseware development include mutual entrainment within the institution or company, such as multi-functional groups or roles as well as mutual entrainment with external rhythms such as consumer patterns or external technological advances. Recognizing the existence of mesh, or mutual entrainment, pushes researchers to identify the determinants in which mutual entrainment of courseware development rhythms would decrease development time.

3.3 Tempo in Courseware Development

Mutual entrainment alone may not accelerate courseware development unless the courseware development rhythms are entrained or re-entrained to an appropriate pace or cycle. This section discusses tempo or tempo entrainment, the pacing of meshed rhythms or patterns such as those considered above, and its effects on courseware time. There are a number of internal and external pacers manifested throughout the development process. For better or worse, the pacers tend to capture the process and force it to proceed at a certain tempo. The following discussion first addresses internal pacers and their effects on the tempo of courseware development, then considers external pacers, and finally appraises the issues surrounding the decoupling and re-entraining to appropriate pacers.

Internal pacers or entraining cycles include budget and funding cycles, strategic planning cycles, project or phase review cycles, and projected milestone completion dates. The tempo that these pacers impose may not be the most appropriate for courseware development.

Certain external pacers also have a marked effect on the courseware development tempo. [Stalk & Hout 90] conclude that the pace of innovation varies from industry to industry, depending on the specific development cycles and what specifically drives those cycles. At one extreme is the eight-to-ten year tempo of the pharmaceutical industry, with the pace of government and nature itself capturing the industry's tempo; the pace of the FDA can be viewed as an uncontrollable zeitgeber in this case. At the other extreme, [Stalk & Hout 90] refer to the television news industry, in which product development cycles are measured in hours or minutes. The consumers' desire to know what is news as soon as it is news drives the cycle. Courseware development for the web faces both the fast pace of technological advances and the more stodgy pace of traditional instructional design.

On the other hand, some rhythms naturally resist entrainment to pacers. In the biological examples of entrainment, a rhythm naturally occurring as nearly a 24-hour rhythm was easily entrained to an exact 24-hour cycle. But in terms of courseware development, changing to a new tempo may not be that easy. For example, [Rosenau 92] lists forcing scientists to "invent on schedule" as a classic development delay.

Another possible source of resistance to entrainment springs from the varying difficulties encountered with the type or extent of innovation involved in courseware development. Courseware projects can range from mere production tasks to full-scale research and development of technology and pedagogy. Although different types of innovation project paces might not be as obvious as the circadian cycle, different types of projects seem to require or capture different rhythms or patterns--which in turn are related to speeding the development timeframe.

The linking of courseware development rhythms and patterns to each other and to appropriate pacers or entraining cycles is critical to increasing the tempo of new product development.

4. Conclusion

This paper began with a discussion of the entrainment concept manifest in biological and social systems. Possble applications of rhythm, mesh, tempo, and pace in courseware development were explored, along with possible links to accelerating courseware development. Application of entrainment to courseware development has the potential to provide researchers with an underpinning theory of courseware development acceleration to move research from a better understanding or co-variations to discovering important causal elements. The fulfillment of these aspirations will likely help the delivery of new courses "on a horse" that is quick and sure-footed.

5. References

Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review*, 80, 41-47.

Ancona, D. G., & Caldwell, D. F. (1992). Demography and Design: Predictors of new product team performance. *Organization Science*, *3*(3), 321-341.

Aschoff, J., Hoffman, K., Pohl, H., & Wever, R. (1975). Re-entrainment of circadian rhythms after phase shifts of the Zeitgeber. *Chronobiologia*, 2, 23-78.

Berger, P. L., & Luckman, T. (1966). *The Social Construction of Reality*. New York: Anchor Books.

Bluedorn, A. C., & Denhardt, R. B. (1988). Time and organizations. *Journal of Management*, 14 (2), 299-320.

Bower, J. L., & Hout, T. M. (1988). Fast-cycle capability for competitive power. *Harvard Business Review*, 66 (November-December), 110-118.

Brown, F. M. (1982). Rhythmicity as an emerging variable for psychology. In F. M. Brown, & R. C. Graeber (Ed.), *Rhythmic Aspects of Behavior* (pp. 3-38). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Clark, K. B., & Fujimoto, T. (1990). The power of product integrity. *Harvard Business Review*, 68 (November-December), 107-118.

Condon, W. S. (1978). An analysis of behavioral organization. *Sign Language Studies*, 13,

Foster, R. N. (1986). Timing Technological Transitions. In M. L. Tushman, & W. L. Moore (Ed.), *Readings in the Management of Innovation* (pp. 215-228). Cambridge, MA: Ballinger Publishing.

Gersick, C. J. G. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal*, 31, 9-41.

Graeber, R. C. (1982). Alterations in performance following rapid transmeridian flight. In F. M. Brown, & R. C. Graeber (Ed.), *Rhythmic Aspects of Behavior* (pp. 173-212). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Gupta, A. K., Raj, S. P., & Wilemon, D. (1985). The R&D-Marketing interface in high-technology firms. *Journal of Product Innovation Management*, 2 (March), 12-24.

Gupta, A. K., & Wilemon, D. L. (1990). Accelerating the development of technology-based new products. *California Management Review*, 32 (2), 24-44.

Gurvitch, G. (1964). *The spectrum of social time*. Dordrecht, Holland: D. Reidel Publishing Co.

Hall, E. T. (1983). *The Dance of Life*. Garden City, NY: Anchor Books.

Imai, K.-i., Nonaka, I., & Takeuchi, H. (1985). Managing the new product development process: How Japanese companies learn and unlearn. In K. B. Clark, & R. H. Hayes (Ed.), *The Uneasy Alliance* (Cambridge, MA: HBS Press.

Katz, R. (1982). The effects of group longevity on project communication and performance. *Administrative Science Quarterly*, 27, 81-104.

Katz, R. (1988). Organizational socialization. In R. Katz (Ed.), *Managing professionals in innovative organizations: A collection of readings* (pp. 355-369). Cambridge, MA: Ballinger Publishing Co.

Koepchen, H. P. (1990). Physiology of rhythms and control systems: an integrative approach. In H. Haken, & H. P. Koepchen (Ed.), *Rhythms in Physiological Systems* (vol. 55, pp. 3-20). New York: Springer-Verlag.

Lawrence, P. R., & Lorsch, J. (1967). *Organization and Environment*. Boston: Graduate School of Business Administration, Harvard University.

McGrath, J. E., Kelly, J. R., & Machatka, D. E. (1984). The social psychology of time: Entrainment of behavior in social and organizational settings. In S. Oskamp (Ed.), *Applied Social Psychology Annual* (V5, pp. 21-44). Beverly Hills, CA: Sage.

McGrath, J. E., & Kelly, J. R. (1986). *Time and Human Interaction*. New York: The Guilford Press.

Parkinson, C. N. (1957). *Parkinson's Law*. Cambridge, MA: Riverdale Press.

Rose, K. J. (1988). *The Body in Time*. New York: John Wiley & Sons, Inc.

Rosenau, M. D. (1990). *Faster New Product Development: Getting the Right New Product to Market Quickly*. New York: AMACOM.

Rosenau, M. D. (1992, 2). Faster New Product Development: Accomplishments and Essential Elements. *Visions*, pp. 15-17.

Schmenner, R. W. (1988). The merit of making things fast. *Sloan Management Review*, 30 (1), 11-17.

Smith, P. G., & Reinertsen, D. G. (1991). *Developing Products in Half the Time*. New York: VanNostrand Reinhold.

Stalk, G. J., & Hout, T. M. (1990). *Competing Against Time*. New York: The Free Press.

Takeuchi, H., & Nonaka, I. (1986). The new product development game. *Harvard Business Review*, 64 (January/February), 137-146.

Thompson, J. D. (1967). *Organizations in Action*. New York: Mc Graw-Hill Book Company.

Tichy, N., & Charan, R. (1989). Speed, simplicity, self-confidence: An interview with Jack Welch. *Harvard Business Review*, 67 (September-October), 113-121.

Tushman, M. L., & Romanelli, E. (1985). Organizational evolution: A metamorphosis model of convergence and reorientation. In L. L. Cummings, & B. M. Staw (Ed.), *Research in Organizational Behavior* (vol. 7, pp. 171-222). Greenwich, CT: JAI Press.

Von Braun, C.-F. (1990). The acceleration trap. *Sloan Management Review*, 32 (1), 49-58.

Wilkinson, R. T. (1982). The relationship between body temperature and performance across circadian phase shifts . In F. M. Brown, & R. C. Graeber (Ed.), *Rhythmic Aspects of Behavior* (pp. 213-240). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

A New Role for the University in the Information Age

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Abstract: This paper will propose an emerging role for the University in light of the technological tidal wave that has occurred in the recent decade. It will scan the changing landscape facing higher education, re-evaluate who the learner is, highlight the expanded learning community opportunities, and underlying the entire paper, introduce a new philosophy for Universities to follow: teaching and learning, from cradle to grave.

1. Introduction

What is the role of the University? Traditionally, it has a few major components: a place for the high school graduate to expand his/her higher learning processes, a center for worldwide research, and a place for those seeking expanded specialized education, particularly in the professional fields, such as law and medicine. In the past decade, this role is coming under increased pressure and may need to be redefined if the University is to grow, much less continue, in the next century.

This paper recognizes the value in the traditional University model. The experiences of the residential campus, students away from home for the first time, living with other students from different religions, ideologies, and geographics is integral to the maturity process that should complement any academic achievements. With the emergence of technology, these benefits can be enhanced with new resources, experiences and environments that were never before possible.

The University is uniquely positioned to be the focal point for learning in the information age. To be this learning hub, it needs to foster the coming together of both young and old who are on the path of knowledge. While specific learning opportunities are important, the main point of this paper is to introduce that the University should be positioning itself to expand its identity and role to cater to the expanding learning community.

2. The Changing Landscape

Higher education institutions of all sizes are coming under increased pressure to provide a learning community to traditional and non-traditional learners. This is happening in the midst of additional education providers aggressively moving into the teaching and learning enterprise. Some of these players didn't even exist several years ago! With the ability to provide content via the Internet, now educational opportunities are available from corporations, textbook publishers [see Mendels 1999a], and even colleges that only exist in the virtual sense.

Many established Universities are beginning to recognize the changing educational landscape as well. Stanford is one of the most aggressive institutions in exploring online academic offerings. The Stanford Online web site states the following premise:

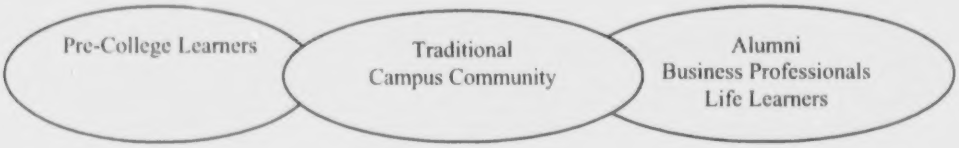
> The virtual classroom could not have become a possibility at a more opportune time. Three educational trends are currently on a collision course. Firstly, education has become and will continue to become increasingly important for occupational and personal success. Second, increasing demographic and occupational diversity is rendering many long-held assumptions about the education process obsolete. This in turn is creating increasing pressure for alternatives. And lastly, education has become increasingly expensive, with cost increases leading inflation by a significant margin. There is now increasing pressure to re-engineer the educational process to be significantly more cost effective [Stanford 1999].

In addition to established Universities who are exploring this changing landscape, some institutions now exist in only the virtual world, with an Internet presence representing the core of the school. While some may think that these don't pose much of an alternative to the established Universities with real campuses, these virtual colleges are beginning to gain in stature. For example, Jones International University, one of the few virtual Universities, has recently received accreditation from the same body that accredits institutions such as Northwestern University, the University of Notre Dame, and the University of Michigan [Macavinta 1999].

Another player in the educational arena is the private corporation. Historically, they have always been involved in post-graduate training as it relates to a specific need of the employer. Now they are beginning to cross over into many traditional teaching areas. This paper will highlight some examples of this involvement by the private sector. These examples should not be taken, necessarily, as threats to the University, but as opportunities for both to work together to enhance the learning experience.

3. The Expanded Learning Community

Like never before, the University has the ability to extend its reach to new communities of learners. These communities span all ages - from high school students to those well past the traditional college age, looking for life lessons. There are three main communities that the information age presents to Universities, each with important needs and priorities. These communities are outlined in the graphic below:



Before introducing each area, it should again be noted that the importance is not just in highlighting each learning group, but that the strength of the University would be to create an environment where all three groups coexist within the context of a single learning community.

3.1 Pre-College Learners

The traditional model states that the undergraduate admissions area of a college or University is focused on attracting the brightest high school students and that the academic departments focus on teaching those same students once they've enrolled. Many institutions try to find ways to market the academy through campus workshops for high school students, faculty involvement either via email or in person, and campus visits, just to name a few admission strategies.

Attracting these prospective students, especially for the more selective institutions, is tough. In a recent article that deals with the current job market and how the dynamics have changed dramatically in the recent decade, there are strong parallels to the change in how high school students may be courted by the academic institutions:

> For companies, the rules of recruiting have changed dramatically. What's out is the notion that an employer can simply show up at interviews and collect the talent. What's in is pitching to hot prospects early and often. You don't start with the senior class at the top Universities - you introduce your company to the freshman class. You sponsor research in the labs. You build relationships. Soon the top performers are using your software. You've given them free Internet access for four years. So when other companies show up

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> on campus and host another cattle call, you've established your brand among the people who can take your company where it needs to go [Breen 1998].

Today, the opportunity exists to involve these students unlike ever before. It is now possible to allow high school students to experience – directly – the academic strengths of the institution, by welcoming them into the University learning community well before they ever step foot on campus.

A typical high school student, while taking all of the proper standardized tests and working towards graduating from high school, might also be looking forward enough to take Advanced Placement tests. With the advent of technology, that high school student could take classes online (through the University) specifically designed to prepare for these placement tests.

Private industry is already offering these tutorials online. From a recent article in the New York Times:

> Like 54,000 other high school students, Elizabeth J. Hanson plans to test her grasp of everything from the Federalist Papers to theories of bureaucracy when she takes the Advanced Placement examination in U.S. government and politics May 18.
>
> Unlike most of them, however, she will have prepared for the rigorous test, which can help high-scorers get college credit, largely by sitting in front of a computer connected to the Internet.
>
> Hanson, a senior at Charlotte Catholic High School in North Carolina, is one of a pioneer group of 150 students who enrolled this semester in an Advanced Placement course offered on the Web by APEX Online Learning Inc., a new company whose executives are convinced there is a market for Advanced Placement classes online [Mendels 1999b].

In addition to offering online tutorials for placement tests, the University could explore the offering of an actual introductory-level course to high school students who don't have access to college-prep curriculum in their local high school. In partnership with high schools, this would allow many students the chance to explore the educational academy by taking part directly in the University curriculum. These classes could be offered in the summer, thus not impeding on the high school students' standard workload.

What's exciting about this opportunity is that the high school student is not just limited to the college-level courses in their geographic area, but if qualified, any University across the country would be possible options.

As part of the University learning community, the high school student would also have access to college students who have taken the same course. This allows for mentoring to take place and possibly the ability for the college student to earn academic credit for tutoring these high school students online.

Another benefit of offering introductory-level courses online to high school students is that in some institutional environments, this strategy is less threatening to traditional academic leadership because it doesn't necessarily disrupt the on-campus fabric of education.

3.2 Traditional Campus Community

Some interesting milestones have occurred in recent years that are profoundly affecting the education process. The ability to provide academic courses online is one such milestone. As already noted, Stanford University is an example of a leading academic institution that currently offers not only individual courses online, but also an entire academic degree that can be earned through the Internet. Now schools are joining together to provide a bank of courses available that are accepted for credit in any of the partner schools. For example, the Indiana College Network offers almost 500 online academic courses. These courses are offered through the largest institutions (Indiana University and Purdue University) as well as smaller private colleges throughout the state [ICN 1999].

What happens when and if on-campus traditional students want to enroll in an online course offered by another school as part of their normal semester load? This is a question that traditional college students could soon be asking their institution. It is an accepted practice to allow this option outside of the traditional semester (summer for example). Now, however, nothing is technically stopping this class from being offered during the semester as part of a student's normal workload. Like many examples in this paper, this possibility should be considered an opportunity for the academic institution. Each University or college could provide students courses in a variety of subjects that were not economically possible in the past. This could help to promote expanded collaboration between Universities and colleges around the world.

For an institution to explore this issue, understandably, there would be many issues to work through. Some of these issues include the sharing of finances, academic standards, transferal of credits, and the logistics of class scheduling. The point is that the current student now could have the opportunity to blend the local academic experience with remote learning as an enhancement to the entire learning process.

Another recent milestone has been the exploding availability of digital information on the Internet. As highlighted later in this paper [see Digital Resources], the University needs to find ways to give the traditional campus student direct and appropriate access to this new wealth of information. When it all comes together, campus students could have access to outside experts, alumni, faculty from other institutions, libraries of information, and resources in the private sector. As an enhancement to the traditional classroom time, the student could consult with other content experts, view the actual data, and discuss the topic with other students throughout the world, without ever leaving the dorm room!

The reality is that a local or regional college could provide world-class resources by enlisting technology to welcome these outside partners into their learning community. Historically, only those who could afford to hire the experts and build the libraries were able to expose their students to these types of resources.

3.3 Alumni and Extended Learning Community

Learning has continued to be a life-long journey. The University has the opportunity unlike ever before to be an integral part of this process. In addition to the on-campus classes, what if the University offered graduate, certificate, and enrichment courses to adult professionals across the country? Through the Internet and complimentary technologies, the learning community could receive convenient local access to world-class education. In fact, some Universities are providing these courses today.

What's important here is finding ways to expand the crucial underlying aspect, maintaining the relationship between the University and the learner. The University has a tremendous opportunity to provide a plethora of resources to alumni, business professionals, and those seeking information about life choices. The goal is for the University to mold the learning community in a such a way that it responds to the changing needs of this group - very much like it maintains a learning environment designed for its on-campus students. These diverse learners can use the University to discuss topics, attend a virtual lecture, provide mentoring, conduct research, and so much more.

An added benefit of expanding the learning community is the resources made available may not have to be standard academic courses. Many learners who have graduated from college often seek guidance and information about important life choices. Universities across the country are a perfect place for offering these resources online to those who are looking for this type of guidance. The University of Notre Dame, for example, offers campus workshops and videos that explore different topics ranging from the changing American family, death of a spouse, and medical ethics [Notre Dame 1999]. The next step is to offer these workshops online so that someone can experience these resources without having the luxury of being in South Bend.

Partnership opportunities in this area are also on the rise. Corporations, who are in desperate need of skilled workers, are spending tremendous resources to find ways to train existing employees as well as plant the seeds of the importance of education to those still too young to be considering higher learning. As an example, Joint Venture: Silicon Valley is spending millions of dollars on a partnership with Silicon Valley elementary, middle, and high schools [Joint Venture 1999]. The goal is to promote the importance of preparing youth for the world of today and tomorrow, one that places supreme importance on the information worker. Although that particular partnership does not involve any colleges or Universities, the time is ripe for higher education to join with the private sector in these expanding educational opportunities. In fact, it is already happening in some very public arenas. Unext.com is one such effort. Formed as a separate company, Unext.com is partnering with Universities to provide educational opportunities to the business world. Their goal is "to create powerful learning communities that marry the world's most respected academic scholars and institutions with the global reach and interactive capabilities of the Internet" [Unext 1999].

So whether it's a professional looking for a career change, a remote scholar conducting research, someone looking to expand their knowledge in a certain discipline, or an adult looking for guidance in a life situation, the University has the tremendous opportunity to be an important resource for guidance and information. With the expansion of the Internet, this relationship has the potential to last a lifetime!

4. Digital Resources

A critical element in building and maintaining this expanding role is the availability of online resources. These are online resources that could relate directly or indirectly to the University curriculum. The University should be viewed as the keeper of these valuable resources, making them available to the worldwide learning community. An example of providing these resources online can be found in a joint effort between the private sector and University publishers called netLibrary. With 8,000 volumes currently available, users can search for scholarly, professional, or reference books, and then view the entire contents online. NetLibrary is partnering with over 40 publishers that include Harvard Business School Press, Macmillan Reference, McGraw-Hill Companies, MIT Press, and University of California Press [netLibrary 1999]. While the readability of online books is still in question, one has to ask if it is better than not having access to this information at all. Beyond simply providing books online, Universities should also be finding ways to provide content that enriches all senses, thus allowing for a deeper understanding of the subject matter, including images, sounds and video.

The value in making these resources available to a wider audience through the Internet is reaching the agenda of government as well. President Clinton has asked for $30 million for the creation of a digital library for education. If the money is approved, it could eventually mean that images of items like the pages of Thomas Edison's lab notebooks and the hat worn by Abraham Lincoln the night of his assassination would be online, and freely available to students and the public at large [Mendels 1999c].

Higher education should be aggressively exploring these opportunities so that the University is properly positioned as an important part of these learning resources. Unlike corporations and even governments, the University can blend these resources into the learning community providing the proper context and instruction that truly make these digital resources valuable to the learning process.

5. Interesting Possibilities

Some of the following possibilities highlight the potential of the lifelong learning model. In fact, some may already be happening across the country:

- A senior in a small Midwest college is earning credit for assisting a faculty member who is teaching an introductory-level course. The difference is that the faculty member is teaching this class in a large state school in Florida. The student teaching assistant is earning credit by making herself available twice a week on the Internet for tutorial sessions and as a resource for student questions.

- A college junior studying overseas for the semester is able to finish a required class, thus staying on track for graduation. The required class is only offered back in the student's American campus, but he is able to take and complete the entire course online during his semester abroad.

- During the summer, an introductory Philosophy course in this southwestern University not only has the typical number of college students, but also two high school students who have been accepted into the class. They are taking it because their high school doesn't offer any college prep classes and if they pass, they will earn credits transferable to any partnering college or University.

- A high school teacher is working on expanding her knowledge in an emerging field. With that goal in mind, she is taking a couple of courses during the summer from two different Universities – both online.

- An alumnus who lives overseas is auditing an online Biology seminar. This alumnus has always been extremely interested in the subject but never had the chance to learn more about field.

- A college senior is offered a position based partly on knowing an alumnus online through the University learning community.

6. Conclusion

With technology, the University has the ability to market itself more effectively to prospective students (young and old), create a far-reaching learning community for all its members, and retain relationships with those who come and go from the academic landscape. Thus, the new philosophy for higher education involves learning from cradle to grave!

7. References

[Breen 1998] Breen, Bill. (1998, April). Money isn't everything. *Fast Company Magazine* [Online] Available: http://www.fastcompany.com/online/14/everything.html (1999, May 12)

[Macavinta 1999] Macavinta, Courtney. (1999, March 10). Short take: online university receives accreditation. *CNET News.com.* [Online] Available: http://www.news.com/News/Item/0,4,33605,00.html (1999, May 12).

[Mendels 1999a] Mendels, Pamela. (1999, June 2). Textbook publisher plans online university. *The New York Times.* [Online] Available: http://www.nytimes.com/library/tech/99/06/cyber/education/02education.html (1999, June 17).

[Mendels 1999b] Mendels, Pamela. (1999, April 28). Advanced placement courses offered online. *The New York Times.* [Online] Available: http://www.nytimes.com/library/tech/99/04/cyber/education/28education.html (1999, May 12).

[Mendels 1999c] Mendels, Pamela. (1999, February 3). President Proposes Digital Library for Education. *The New York Times.* [Online] Available: http://www.nytimes.com/library/tech/99/02/cyber/education/03education.html (1999, May 1).

[ICN 1999] *The Indiana College Network.* [Online] Available: http://www.icn.org/ (1999, June 2).

[Joint Venture 1999] *Joint Venture: Silicon Valley.* [Online] Available: http://www.jointventure.org/ (1999, May 14).

[netLibrary 1999] *netLibrary.* [Online] Available: http://www.netlibrary.com (1999, June5).

[Notre Dame 1999] *Notre Dame Alumni Continuing Education.* [Online] Available: http://alumni.nd.edu/cont_ed/ (1999, April 3).

[Stanford 1999] *Stanford Online.* [Online] Available: http://stanford-online.stanford.edu/ (1999, April 14).

[Unext 1999] *Unext.com.* [Online] Available: http://www.unext.com/ (1999, May 25).

The SAGRES Virtual Museum with Software Agents to Stimulate the Visiting of Museums

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Abstract: The SAGRES system is an environment built on the Web, that facilitates the presentation of information bases of the museum, in a way which is adapted to the individual characteristics of each visitor. The interaction with the system may occur individually or in groups of students. The system offers also resources to support some forms of cooperative learning, allowing visitors to interact both synchronously and asynchronously, and both, locally, inside the museum, and non-locally, in places geographically distant from the museum. This cooperative learning is stimulated and monitorated by software agents that use the humam-computer interaction paradigm called directed improvisation to interact with the user. The agents improvise, while helping the user, a group of behaviors similar to human behaviors (happyness, satisfaction and vibration), making the interaction more friendly.

1 Introduction

Most of the virtual museums on the Web are sites that offer on-line learning resources, inviting the visitor to investigate and to explore the information available. The SAGRES system is a virtual museum that seeks a cooperation between museum and schools, in order to create a new educational environment that provides continuous education, allowing access to information of the museum to the community in general. It aims to help cooperative learning processes of visitors, both local and remote. Due to the possibility of using the system as a distance teaching tool, and to the diversity of the school population to be reached, SAGRES was conceived as a flexible and adaptive system, able to pay attention to the different needs and situations of its various visitors.

The hypermedia systems on the Web are among the many systems that facilitate the adaptation of information. These systems are an efficient form to manage data collections too, as well as to bring into effect education and learning in museums. However, Yamada et al. [1995] state that hypermedia systems for education in museums present some limitations, such as: the lack of initial training from the part of the user; the time of limited use of the system (just during the visits); the different ages and the different levels of the users' background. To overcome these limitations, Nielsen [1990] emphasized the need to facilitate the use of such systems. They should be simple, so that the visitors can navigate without needing a training period, their simplicity, being related to the reduction of the navigation options in the interfaces.

Complementing Nielsen's proposal, we are using software agents to assist users in SAGRES. According to Genesereth [1994] software agents are very useful to analyze informantion and to monitorate the user's actions, helping them in the performance of tasks. In this way, the agents are able to facilitate the system's operation, to construct a user's history, with topics visited and activities performed, and to generate reports based on the user's history.

People are social beings and need to interact with each others. In fact, we enjoy and thrive on affective relationships with other social beings at home, at work and at play [Hayes-Roth 1998]. In this way, our agents are animated characters that resemble real and fictional characters. They do this, improvising a set of behaviors while executing the user's request.

We can visualize the organization of the whole system through figure 1. It shows that the SAGRES is built on the Web and the agents are running on SAGRES. The integration of the agents into the SAGRES was made through agents procedures calls inside SAGRES. At present, SAGRES can be reached at the URL http://sagres.mct.pucrs.br/.

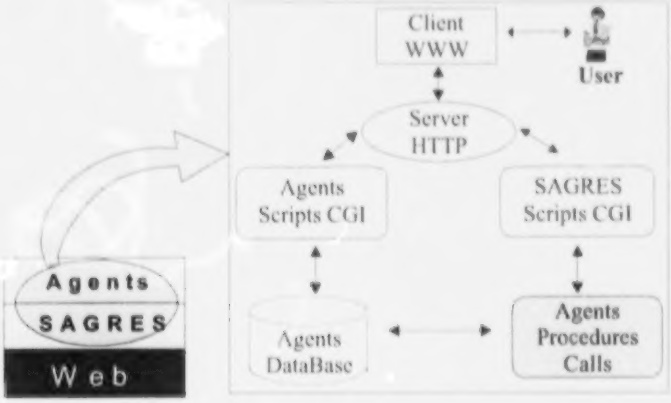

Figure 1: System Organization

2 SAGRES

The SAGRES system [Bertoletti 1999] is an educational environment, that facilitates the organization of visits to museums, presenting museums information bases in a way adapted to the user's characteristics (capacities and preferences). The system determines the group of links appropriate to the user(s) and showing them in a resultant HTML page. In addition, SAGRES carriers cooperative learning by supporting the interaction among visitors and also among members of groups of visitors.

SAGRES allows visitors to plan visits to the museum in advance. Thus, when arriving at the museum the visitor already knows from where to find the specific experiments. Later on, already at home, the visitors can read other information related to the visited experiments, as support material available in the system.

For teachers SAGRES is a powerful tool to support education, because it works as a repository of information from which the teacher can elaborate a library of activities (for example: questionnaires for tests) and share them with other teachers.

Basically, the system is handled by different groups of users:

- *System Administrator*: responsible for the maintenance of the system, having a deep knowledge about its

- *Information Manager*: responsible for the information bases of the museum, generating them and establishing the degree of difficulty of each piece of information.
- *Teacher*: is generally identified as a school teacher whose student groups visit the museum, being responsible for the definition of the profile of the group. By a profile we understand the set of characteristics of the

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group, that is, the students' background and preferences, any particular subject being focused in the visit, and the activities. The techer is also responsibility to register the students, as well as to accompany and evaluate their performance during the visit, through reports delivered by the system.

- *Visitor*: any individual visitor of the museum. A visitor can interact with the system as both is:
    - An Individual Visitor: he accomplishes the interaction with the system individually. He is included in the system by a process of self-registering, in which he is responsible for defining his profile, informing his characteristics, capacities and preferences, in order to facilitate the construction of his model.
    - A Student: he is allowed to change ideas with his group colleagues and to work in the activities and subjects determined by the teacher.

2.2 Adaptation of Information

In the adaptation process of SAGRES two main factors are considered: its use in the educational atmosphere (museum and school) and the different types of visitors that use the system. In this sense, the system uses an *adaptive presentation of information*, so that the user just receives, as a result of his consultation, the information that is in agreement with his level of understanding, stored in his visitor model.

The modeling module receives the information about the visitor, processes it and generates the visitor model, storing it in the database of models. The acquisition of knowledge about the visitor is done in an explicit way: information is directly extracted, through the filling of forms, with direct answers to questionnaires. SAGRES works with two kinds of models: individual model and group model. The individual model stores all the characteristics of the individual visitors. The group model is built by the teacher and used by students. The teacher is responsible for the definition of the students characteristics, by the definition of the group stereotype (subject, knowledge level and language of the consultation), the activities stereotypes and the classes (name of the students presented in the group). The activities stereotypes can contain: "n" questions (true or false; multiple choice; to relate columns and dissertation); "n" orders (that specify the teacher's desire before the students' course in the system); " n " editions of documents (where the teacher requests the students the report writing, for example) and " n " discussions (where the students change messages in order to discuss certain themes established by the teacher).

Once defined, the group and activities stereotypes can be used for the construction of several models, which store codes for the identification of them. The control of the use of the stereotypes fits to the teacher, that can also share them with other teachers.

The adaptation process accomplishes the mapping of the information (documents about the experiments in exhibition and works published by the staff of the museum) contained in the information bases for a presentation page, in accordance to the visitor's model. Such mapping results in a dynamically created HTML page, with links pointing to information selected. This page is created dynamically in each interaction and presents links to the documents, besides presenting connections to the communication mural (where visitors can interact with each other), to the document edition, and to the activities the visitor should perform (in case of a group visit). The visitor can use this page as a visitation guide to the museum.

2

The cooperation process in the SAGRES happens in two ways:

- Communication Mural: allows the students of a group to send messages to each other, facilitating local and remote communication among them, very important to the learning process. In this mural the students place their ideas, questions, comments and help messages. When the group model is created, the system automatically generates an HTML page, which works as a communication mural. The mural can only be used by the students of the group. The teacher also has access to this mural, facilitating the coordination of the cooperative process.
- Document Edition: The cooperation process in the SAGRES system also facilitates the edition of HTML documents on the part of the students. These documents, unlike the communication mural, are available to all users of the system. In such documents the students state their ideas on the consulted subjects, they add new information associated to that already presented and, also, arrange the related works.

3 Agents

In order to develop a system that can be more friendly, assisting the users in SAGRES, through the communication between the users and animated characters, our agents use the human-computer interaction paradigm called directed improvisation [Hayes-Roth 1997] . Based on the metaphor of the virtual theater, it was developed a muti-agent architecture formed by four kinds of agents: director, guide, presentation and assistant. Figure 2 shows the way these agents are organized. The innovative and peculiar feature of this architecture is the existence of the director agent, responsible to connect the behavior to the actors, in an improvised way. Therefore, the actors have different personalities and different ways to interact with users. We call this director's behavior "improvised direction", in order to distinguish it from directed improvisation.

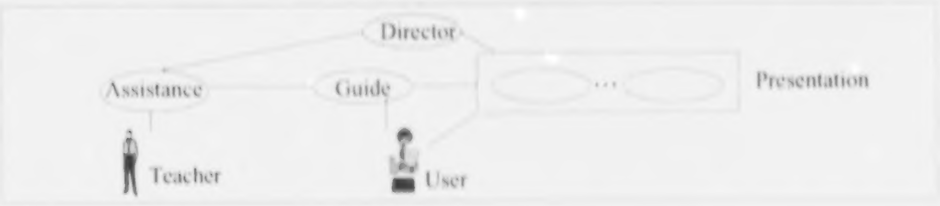

Figure 2: Global arquitecture of the agents

Hayes-Roth [1994] defined directed improvisation as a paradigm for human-computer interaction, where users give character abstract directions either interactively or in preconceived scripts. The characters improvise a course of behavior that follows the directions, expresses their individual styles and reflects social principles. The directed improvisation is incorporated in the architecture in the following way: each one of the agents has a script that contains the actions to be executed by the agent and a behavior related to these actions. Two kinds of behaviors have been defined: interaction, which occurs when the agent interacts with the user, and processing, which occurs when the agent processes a request from the user. The interaction behaviors incorporate the verbal behaviors (word choices) and physical (movement behaviors) of the agents. It has associated instances for each of the interaction behaviors of the agents. As the verbal behaviors define the personality of the agent, we defined different "personality instances" for the guide agents, presentation and assistant, provinding varied personalities to them. The director agent is responsible to choose, in an improvised way, which behaviors will be related to the agents actions. Figure 3 shows the director's script, with some of its funcionalities. The guide agent is responsable to assist users and built their history. A reduced format of the guide agent script is presented in the figure 4; the text in italic is representing the behavior that the agent can improvise at that moment.The assistant agent helps teachers to construct visits and to monitorate a students' group and the presentation agent presents the contents requested by the users.

We may notice in the figure 4 that an action can have more than one associated behavior. In this way, the agent has to choose which behavior will be improvised. Beyond these scripts each agent has a data structure, the same for all, that is: id_agent (contains the name of the agent), state_agent (contains the current internal state of the agent), list_neighbours (contains the name of the agents that it will be able to communicate to) and who_is_communicating (contains the name of the agent that is communicating at the moment). The agents have common knowledge about the world, which is implicitly incorporated in the program structure.

1. To construct the agents' scripts, connecting, in na improvised way, behaviors to the agents' actions.
2. To inform these scripts to the agents.
3. To manage the execution of the agents.
4. To create a solution when it doesn't exist a guide agent to guide a user or it doesn't exist a presentation agent to present some specific topic requested by the user.

Figure 3: Example of Director agent's script

1. To present to the visitor (*to greet, to wave)*
2. To invite the visitor to make a visit to the museum *(to invite, to dance)*
3. To wait reply of the visitor *(to wait)*
   - 3.1 If visitor selects a consultation
     Looks to presentation agent for content (*researcher)*
     Demonstrates satisfaction *(satisfaction, vibration)*
   - 3.2 Else demonstrates reprovation *(to refuse, to disapprove)*
     Stimulates visitor to make visit *(to stimulate, to move)*
   - 3.3 If visitor requests mural's monitoring
     Monitorate communication mural *(investigating, artist)*
   - 3.4 If visitor requests the monitoring of document edition
     Carries through edition of document *(researcher, artist)*

Figure 4: Sample of Guide agent's script

The communication between agents is carried out through sending and receiving messages. A set of messages was created to use in the interaction between agents; some of these messages can be seen in figure 5.

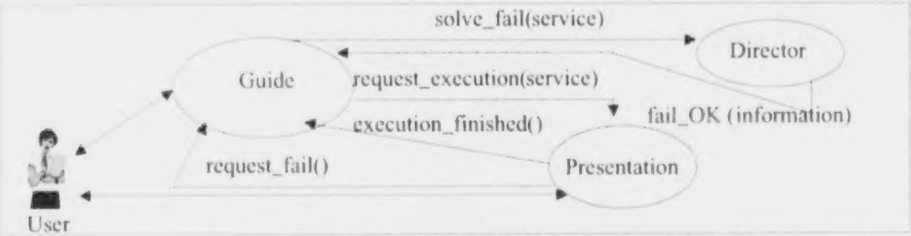

Figure 5: Sample of Communication in an individual visit

Running on SAGRES, the agent carries through the assistance of users, constructing the users' history, that is the topics visited and activities performed. The agents are constantly looking for new messages in the communication mural and informing the user who writes the message and what is its content. The agents execute also the procedure of looking for documents edited by other users, suppling access to these documents. The system also supports some facilities to the teacher, when a group visit is occuring. Based on the user's history, the agents generate reports to the teacher. There are three kinds of reports: group's report, that lists all activities made by the group, including communication mural and document edition, student's report (lists activities partialy or completly performed by the student, with his grade) and activities' report (lists percentage of activities finished by the group and degree of correct and incorrect answers).

4 Conclusion

A virtual museum, in the pattern proposed by SAGRES, is shown viable, performing among other functions, the support for cooperative learning. SAGRES is being developed to offer to the visitors of museums (local or remote visitors) the chance to learn cooperatively, exploring information adapted to their personal characteristics. The style of SAGRES system demands that the student takes part in the decisions concerning the activities he will perform, and not only to repeat preset routes mechanically.

This way, SAGRES will make remotely available to the public visitor the interactive museum of PUCRS, as well as it will contribute to the improvement of teaching, facilitating cooperative work among students, and promoting the exchange of information among schools geographically distant.

The agents in SAGRES are built in order to offer a friendly interface and to facilitate the management of groups' visits.They do this through the assistance of users, helping them during the exploration of information and system operation. Furthermore, they stimulte communication among students and among visitors, because they are constantly looking for new messages in the communication mural and informing the user the author and contents of the message. Besides, they provide facilities to monitorate group of students.

5 References

1. Bertoletti, A. C. & Costa, A. C. R. (1999) SAGRES – A Virtual Museum. *Museums and The Web 1999 Conference.* USA: New Orleans, Louisiana.

2. Genesereth, M.R. & Ketchpel, S.P. (1994) Software Agents. *Communications of the ACM.* July.

3. Hayes-Roth, B. Sincoff, E., Brownston, N.L., Huard, R., Lent, B.(1994) Directed Improvisation. Stanford University Technical Report – KSL-94-61.

4. Hayes-Roth, B., Van Gent, R. (1997) Story-Making with Improvisational Puppets. *Agent's 97.* USA: California, Marina Del Rey.

5. Hayes-Roth, B., Ball, G., Lisetti, C., Picard, R.W., & Stern, A. (1998) Affect and emotion in the User Interface. *Proc. Int. User Interfaces Conf.*

6. Lewis, L. C. (1997) At home in the Heartland Online: forming a museum/school resource via the World Wide Web. D. Bearman & J. Trant (Eds.) *Museums and the Web, Selected papers from Museums and the Web97.* Pittsburgh: Archives & Museum Informatics.

7. McKenzie, J. (1997) Building a virtual museum community. D. Bearman & J. Trant (Eds.) *Museums and the Web, Selected papers from Museums and the Web97* .Pittsburgh: Archives & Museum Informatics. 77-86.

8. Moraes, M.C. & Rocha, A.C.R. (1998) A system of improvisational agents for the attendance of visits to museums. *II Iberoamerican Workshop on DAI and MAS – Multi Agent Systems Modell Architecture and Applications.* Spain: Toledo.

9. Nielsen, J. (1990) *Hypertext and Hypermedia.* San Diego, CA: Academic Press.

10. Yamada, S., Hong, J. & Sugita, S. (1995) Development and Evaluation of Hypermedia for Museum Education: Validation of Metrics. NY: *acm Transactions on Coputer-human Interaction.* 284-307.

Privacy is a Right and not a Privilege: Why Legislation is Necessary to Protect Privacy

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Abstract This paper discusses the concept of privacy and looks at threats to this right stemming from the electronic age. Legislation, in the form of data protection law is discussed as a means to protect individuals' privacy and the example of the UK Data Protection Act is given to illustrate the scope of legislation in this domain. The reasons as to why the European Union has chosen legislation as the means of protection rather than relying on self regulation are considered. The paper concludes by highlighting the importance of such legislation to counter threats to privacy and outlines its implications for organisations.

1. The concept of privacy

The privacy concept traces back to the famous American jurists Samuel Warren and Louis Brandeis who described it as "the right to be left alone". Although subject to various interpretations privacy concerns the right for individuals to determine to what extent and in what circumstances information about themselves is communicated to others. The right to privacy is enshrined in the Universal Declaration of Human Rights and the European Convention for the Protection of Human Rights. Acceding to Foran privacy means: "that individuals have a right to control the flow of information about themselves, the right to fair, reasonable and confidential information practices. This claim of information privacy assumes that all information about an individual is fundamentally his or her property to communicate or withhold as desired - it is the democratic notion of self-determination or autonomy which, in the case of information, dictates that no one should have more control over a person's information than the person. But the more that can be known about a person, the less the person's autonomy. And these days, in an information society, our individual autonomy and our sense of control are on the line. This is the heart of the privacy problem and that is why privacy has become such an emotionally charged issue" (Foran 1995).

The growth in the amount of information gathered on individuals, the creation of large databases, not least by government, combined with the ability to link information across such databases have brought the issue of privacy to the attention of the public. Growth in database marketing and the activities of credit reference agencies who utilise such large databases have raised public awareness about how much personal information is held in electronic form and the negative consequences which can ensue should such information be found to be erroneous. There is a growing concern over civil liberties and personal privacy especially in respect of personal data contained in for example, medical, financial and employment records.

Another issue with privacy lies in the fact that people's actions and behaviours over electronic networks can be observed and used to draw conclusions about a person's beliefs and interests. These so called transactional data are one of the most controversial items in the privacy discussion.

2. Privacy concerns and the internet

Rapid development of the internet has led to growing concerns among individuals about their personal data and the use to which it is put. For example a survey of net users by GVU states "Privacy now overshadows censorship as the number one most important issue facing the Internet". (GVU 1997) Fears about misuse of personal information are an issue for Net users and there is evident support for privacy laws to be enacted. In particular the use of "cookie" technology which can potentially disclose personal information of unsuspecting Web users is subject to criticism. (Mayer-Schonberger 1997, EPIC 1997)

In the US in particular there have been calls for stronger safeguards to protect personal privacy. The testimony of the Director of the Electronic Privacy Center to the US House of representatives committee on International Relations in May 1998 (EPIC 1998) succinctly states the reasons why to date legislative measures, self regulation and industry codes in the US have failed to give adequate protection to the individual in respect of their privacy.

Technological solutions such as the Open Profiling Standard, the Platform for Privacy Preferences and Truste have not yet met with success. However it is recognised that privacy and related issues such as anonymous payment systems will be important in the establishment and development of electronic commerce. Thus it can be seen that the issue of privacy has come to the fore especially in recent years. In Europe a 1995 Directive on Data Protection (European Union 1995), has firmly established the importance of the issue. Privacy and its protection are seen as inextricably linked with the development of trust in electronic commerce.

3. Generic principles underlying data protection laws

The need to protect privacy in regard to the use of computer systems has been recognised for come time. The OECD Guidelines (OECD 1980) were the first international policy for the protection of privacy in computerised data processing systems. These guidelines were designed in a technology neutral way to accommodate future developments. Much national legislation in this area including the European Directive are based on these principles which apply to all types of personal data whether traffic data or content data. They outline the rights and obligations of individuals in the context of automated processing of personal data and the rights and obligations of those who engage in such processing. These eight principles comprise the following:

Collection Limitation Principle

There should be limits to the collection of personal data and any such data should be obtained by lawful and fair means, and where appropriate with the knowledge or consent of the data subject.

Data Quality Principle

Personal data should be relevant to the purposes for which they are to be used and, to the extent necessary for those purposes should be accurate, complete and kept up to date.

Purpose Specification Principle

The purposes for which personal data are collected should be specified not later than at the time of data collection and the subsequent use limited to the fulfilment of those purposes or such others as are not incompatible with those purposes and as are specified on each occasion of change of purpose.

Use limitation Principle

Personal data should not be disclosed, made available or otherwise used for purposes other than those specified in accordance with the purpose specification principle except: a) with the consent of the data subject; or b) by the authority of law

Security Safeguards principle

Personal data should be protected by reasonable security safeguards against such risks as loss or unauthorised access, destruction, use, modification or disclosure of data.

Openness principle

There should be a general policy of openness about developments, practices and policies with respect to personal data. Means should be readily available of establishing the existence and nature of personal data and the main purposes of their use, as well as the identity and usual residence of the data controller.

Individual Participation principle

An individual should have the right:

a) to obtain from a data controller confirmation of whether or not the data controller has data relating to him;

b) to have communicated to him, data relating to him within a reasonable time; at a charge, if any, that is not excessive; in a reasonable manner; and in a form that is readily intelligible to him;

c) to be given reasons if a request made under paragraphs a) and b) is denied, and to be able to challenge such denial;

d) to challenge data relating to him and, if successful, to have the data erased, rectified, completed or amended.

Accountability principle

A data controller should be accountable for complying with measures which give effect to the principles stated above

4. European Union Directive on Data Protection 1995: Main objectives

The Directive is seen as an essential part of a clear and stable legal framework which is necessary for the development of an information society in Europe. It is designed to ensure that personal data can move freely throughout the Community by ensuring that a high level of protection for individuals in all Member States with regard to processing of such data. This is achieved on the one hand by imposing obligations on those who process data and by establishing rights for the individuals whose data is being processed. The directive is applicable to all files within the public and private sector thus files whether computerised or not fall under the Directive so long as they relate to living individuals and are structured files. Information relating to living individuals gathered over the Internet will therefore have to comply with the principles of the Directive.

5. European Union Directive on Data Protection 1995: Key provisions

The key provisions of the Directive are as follows.
It applies to automatically processed and certain types of manually processed data.
It contains a wide definition of "processing" (i.e. everything from collection to destruction).
It establishes data protection principles with which processing must comply.
It sets conditions which must be met before personal data may be processed with stringent conditions for the processing of "sensitive" data e.g. data about racial or ethnic origin.
It provides for certain exemptions for e.g. journalism, national security, crime investigation
It requires individuals whose data are processed to be provided with certain information (e.g. about purpose of processing).
It gives individuals the right of access to their personal data, and the right to have inaccurate data amended etc.
It gives individuals the right to object to their data being used for direct marketing purposes.
It places restrictions on fully automated decision-making.
It sets specific requirements for ensuring the security of processing operations and
it requires information about processing operations to be publicly available.
Finally it gives detailed conditions for transfer of personal data to countries outside the European Economic Area.

In the United Kingdom the legislation enacted to bring the Directive into force is the 1998 Data Protection Act (HMSO 1998). It is important to understand the overall significance of this legislation for the protection of personal privacy. It makes more stringent demands of data controllers than previous legislation and strengthens individual rights.

6. Implications of the legislation

As the UK legislation is, at the time of writing, so recent the full implications of the new Act are not yet clear but it is useful to highlight two of the most important provisions and explain their significance.

The first Data Protection Principle requires that "Personal data shall be processed fairly and lawfully". The advice of the Data Protection Commissioner is that all data controllers should ask themselves "Do I have legitimate grounds for my processing operations?" One of the conditions for processing is that the processing is carried on with the consent of the data subject. Consent is not defined in the Act but the original Directive on which it is based defines it as:- "... any freely given specific and informed indication of his wishes by which the data subject signifies his agreement to personal data relating to him being processed."

The fact that the data subject must "signify" their agreement means that there must be some active communication between the parties. Data controllers cannot infer consent from e.g. non-response to a communication. In the case of sensitive data this consent must be "explicit". Part of this first principle also requires that data controllers comply with what is known as the "Fair Processing Code". This code set out requirements as to the fair obtaining of personal data and the information that must be provided to the data subject. Compliance with "the fair processing code" should in most cases ensure that consent is both "specific" and "informed" and that the data subject is informed of the purpose for which the data is intended to be processed. With this legislation the use of "cookie" technology which gathers information about the data subject without their knowledge would not be permissible. Organisations would have to ensure that where personal information is gathered over the Internet that data subjects were aware of this and understood the purposes for which that data would be used. Furthermore individuals now have an explicit right to object to their data being used for the purposes of direct marketing - one of the most common uses of information gathered over the internet.

Secondly the eighth Data Protection principle states that "Personal data shall not be transferred to a country or territory outside the European Economic Area, unless that country or territory ensures an adequate level of protection for the rights and freedoms of data subjects in relation to the processing of personal data." European countries are not allowed to send personal information to countries that do not maintain adequate standards of privacy. The European Union does not consider the US to have adequate privacy laws and in December 1998 declared that the proposals for voluntary-based privacy policies as set out in "Safe Harbour" were unacceptable. As a result a huge amount of business between Europe and the US may potentially be blocked in areas such as banking, credit card transactions, ecommerce and travel (Banisar 1998, Davies 1998). Data gathered by US companies on European citizens over the Internet could be considered as breaching this principle and such companies may find themselves challenged in the courts as a result. Privacy International for example has stated that it intends to challenge any "illegal" processing by US companies to protect European citizen's rights.

In contrast the US claim that it has equivalent privacy protection but that it is different, than that existing in Europe. Specifically it relies on self regulation and technological solutions rather than legislation to ensure privacy. This is not seen as being sufficient by Europe and it remains to be seen the extent to which the new privacy laws will be invoked in terms of the transfer of data between the two trading blocks.

7. Conclusions

To date voluntary self regulation has not proven to be adequate in ensuring the individual privacy is protected. Legislation brings the force of law to the issue of privacy. The Internet transcends national boundaries hence national legislation is insufficient. International agreement as to the importance of privacy and commitment to legislating for its protection is necessary. Legislation though is not enough, effective enforcement is also essential. In the case of the UK the previous Data Protection Act of 1984 was poorly enforced not least because of the limited resources of the Data Protection Registrar to investigate breaches of the law. An informed and educated populace is necessary to ensure that individuals understand their rights and wish to see them enforced. A major task for the new Data Protection Commissioner will be to ensure that such education is given a high priority.

There is some evidence to suggest that the public are becoming more concerned about the extent to which information is routinely collected about them and the uses to which it is put. On October 11th 1998 the Sunday Times published an article "Privacy row as firms draw up list of customers' politics". In it the extent to which companies as diverse as Eagle Star, Mothercare and Bupa Care Services collect information on their customers for marketing purposes is revealed. Some of this information is in categories such as race, mental health, political party membership. Under the new data protection act such sensitive information will require the "explicit" consent of the data subject and indeed under the legislation the data subject has the explicit right to object to the processing of any of their personal data for direct marketing purposes regardless of whether such data is in the "sensitive" category. This will require many organisations to reconsider their information management practices with respect to the collection, processing and use of personal data. The same article stated that up to 4m people have taken part in surveys distributed by direct mail often lured into participation by the prospect of a prize. Yet often how this information is used is not known or well understood. The same situation pertains in cyberspace - on a regular basis millions of people give away personal information about themselves often without their knowledge and frequently with little understanding of how it is subsequently used. This situation is likely to change according to John Hagel and Jeffrey Rayport.

In their article in Harvard Business Review "The coming battle for customer information" (Hagel & Rayport 1997) they argue that as consumers take control of information about themselves companies will have to pay for it. Further they anticipate that consumers will not bargain with vendors on their own but rather that companies which they call "infomediaries" will seize the opportunity to act as custodians, agents and brokers of customer information marketing it to businesses on the consumer's behalf which protect their privacy at the same time. They point out that only a few companies will be able to undertake this role - those who have ongoing relationships with customers in a variety of commercial activities and who can earn their trust but this handful of elite service companies could work on behalf of their customers to force a shift toward the ownership of information by consumers. They further argue that this shift in ownership will require businesses in a variety of industries to refocus their information strategies. Once the collection of information is no longer "free" then companies will have to become more selective about the information they collect focusing on what they must know in order to understand and fulfil customers' needs, have to develop skills to use the information to create value for the customer and also how to manage partnership with their customers to ensure continuing access to information.

It can be argued that every business needs to develop appropriate policies and practices to address these issues, regarding both employees and customers. Don Tapscott (Tapscott 1996) suggests that effective privacy strategies will become a requirement for effective business strategies as business shifts to the new information infrastructure. Proactive strategies to address privacy problems can make good business sense but reliance on voluntary measures to introduce such strategies has not been successful. Robust and effective legislation is the only means to ensure that the right to privacy is taken seriously. Legislation can ensure that organisations, both public and private, consciously adopt privacy policies. Accompanied by effective education legislation enables individuals to know exactly what their rights are and how they can be enforced. The growth of the internet increases the threats to privacy. Only through legislation can these threats be countered and can privacy become a right that is adequately protected and guaranteed rather than a privilege.

8. References

(Foran 95) Foran, B. (1995) Chaos on the Information Superhighway. 2nd International Conference on Information Warfare, Jan 18th 1995, Montreal, Quebec

(GVU 1997) GVU surveys are available from http://www.gvu.gatech.edu/user_surveys/

(Mayer-Schonberger 1997) Mayer-Schonberger, V. (1997) The Internet and Privacy Legislation: Cookies for a Treat? *West Virginia Journal of Law and Technology*, Volume 1 March 17 Issue 1. Available at: http://www.wvjolt.wvu.edu/wvjolt/current/issue1/articles/articles.htm

(EPIC 1997) Surfer Beware: Personal Privacy and the Internet. Electronic Privacy Information Center. June Available electronically at: http://www.epic.org

(EPIC 1998) The Electronic Privacy Information Center is a public interest research centre in Washington D.C. It has an excellent set of web based resources privacy, computer security, cryptography, free speech and freedom of information. It can be found at: http://www.epic.org

(European Union 1995) The site for the Legal Advisory Board of the European Union has a section devoted to Data Protection and the text of the European Directive on Data protection can be obtained here. http://www2.echo.lu/legal/en/dataprot

(OECD 1980) OECD (1980) *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data*. Paris, OECD

(HMSO 1998) *Data Protection Act 1998*. Available at: http://www.hmso.gov.uk/acts1998/

(Banisar 1998) Banisar, D. (1998) The privacy threat to electronic commerce, *Communications Week International*, June 1 http://www.totaltele.com/cwi/206/206news13.html

(Davies 1998) Davies, S. (1998) Europe to U.S.: No privacy, no trade. *Wired magazine*, May. http://www.wired.com/wired/archive/topic.html/privacy/6.05_euro_trade1.html

(Hagel & Rayport 1997) Hagel III, J. and Rayport, J. (1997) The coming battle for consumer information. *Harvard Business Review*. Jan- Feb. pp.53 - 65

(Tapscott 1996) Tapscott, D. (1996) *The Digital Economy*. New York, McGraw Hill. Chapter 11 Privacy in the digital economy

Techniques to Implement High Speed Scalable Dynamic On-line Systems

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Abstract. This paper describes the techniques involved in the implementation of high-speed online systems that are efficient, scalable and robust. The Acadia Institute for Teaching and Technology (AITT) at Acadia University has been involved in a software project, called the Automated Courseware Management Environment (ACME) over the past three years. This environment is the backbone for students and faculty at the university, providing a WWW based online system that allows centralization of online testing, discussion groups, course information as well as other features. Although other such systems exist (WebCT, Web Course In a Box), these systems for the most part are not scalable or robust to the point that many institutions require.

Introduction

Many considerations must be taken into account when designing an online interactive system. With the growth of the World Wide Web (WWW), many places are involved in building online dynamic systems to do things such as text searches, making and taking of various tests and surveys, carrying on textual discussions as well as many other tasks. These types of online systems are mostly deployed by writing programs that reside on a server and communicate with users of the Internet by using Central Gateway Interface (CGI). Although other ways exist to deploy online Internet systems it was found that CGI along with the Perl programming language was the most efficient, secure and robust way of implementing the current course management system used at Acadia University (ACME).

This paper focuses on the decisions that were made and the techniques used over the course of the last three years while designing ACME as well as lessons that were learned from the deployment of the system. ACME currently allows the online taking and marking of multiple choice and short answer tests, collaborative discussion groups, organization of uploaded notes, calendar tracking, course information storage and statistics as well as other features. With an online system of this nature much work went into optimization due to the lack of ability to distribute the processing load among clients when using CGI to communicate between the system and it's users.

To present a better understanding of the amount of processing that an online system of this nature may be expected to handle (as well as the benefits for deploying such a system) the following statistics were gathered at Acadia University with a student population of approximately 4000 (of which not all were active on the system). Between the time of September 1 1998 and March 4 1999 (a period of 185 days) the system processed 7,851,578 total requests. These requests were further broken down as follows: Creation of 1,905,086 dynamic web pages, marking of 58,851 online tests, displaying of 45,583 discussion groups, and uploading of 6,855 files. To further amount to what these statistics meant the following scenario was considered: Since ACME marked an average of approximately 318 tests per day for 185 days, if it took five minutes of *manual* marking time to mark each test and a student was paid eight dollars an hour to mark these tests, then the total cost that the system saved on the testing alone over the 185 day span was approximately $39,234.00.

The high demand and overall savings of online systems continue to fuel their growth. Unfortunately with the *success* of a large system come many repercussions. Mistakes that go unnoticed in small systems and lack of optimization are not tolerable in larger highly used systems. For these reasons the main issues that are addressed in this paper are: the programming language used for the system, the operating system support on the server, robustness, optimizations of the system, and scalability.

Choice of Programming Language

In the implementation of web-based systems, three languages are prevalent: C, Java, and PERL. In the development of ACME each language was considered based on the advantages and disadvantages it would provide to the development of the system.

The C language is the most low-level from the three considered because it is less abstract and offers more low-level functionality. It has the ability to directly support any services provided by an operating system, and has the largest user base for general purpose programming of any of the three languages .

PERL (Practical Extraction and Report Language) is a high-level language similar to C, but with specialized support for efficient text processing and data manipulation. PERL has been the programming language of most CGI applications for years because of its text processing capabilities and ease of use. PERL is platform-independent due to its interpreted nature. (In actuality, it interprets PERL code into a byte-code form, which is then run on a virtual machine). PERL also has support for modern programming methods including object-oriented programming, common database access, and Remote Procedure Calls (RPC).

Java is another high-level language with growing popularity in the WWW market, recently developed by Sun Microsystems to be a platform independent, network-aware programming language. It is fully object-oriented, and at the time of ACME's initial development had support for socket-level programming, and simple database access.

The advantages and disadvantages of each language are outlined below:

[The C Language]

Advantages:

Best potential runtime efficiency
Commonly known language
Most flexible language
Established language

Disadvantages

Longest development time
Longer testing time
Poorly suited to processing text
Difficult network programming (no standard interface)
Difficult database programming (as above)

[The Java Language]

Advantages

Shorter development time than C
Shorter testing time than C
Platform independent
Simple network programming (standard API)
Simple database programming (through JDBC)

Disadvantages

Still a growing and changing language
No built-in text processing
Less runtime-efficient than the C language

[The Perl Language]

Advantages

Shorter development time than C and Java
Shorter testing time than C and Java
Mostly platform independent
Excellent text processing
Very flexible language
Large variety of interfaces supported (DBI, RPC, Agents)

Disadvantages

C is more runtime-efficient
Not as established as C

As can be seen above, the PERL language possesses the most advantages for the development of our application (an online system). It has most of the flexibility of C and has Java's advantage of platform independence through the use of virtual machine technology. It is a high-level language with a large library of easy-to-use existing code, including network and database access libraries rivaling and sometimes surpassing the other two languages. The PERL language is not going through the changes that the Java language is now completing through development. It also has the advantage of excellent text processing capabilities, which suits PERL to the purpose of web-based applications very well.

Operating System Considerations

CGI scripts can be executed with various Web servers running under operating systems such as Windows 95/98/NT, SCO UNIX, Solaris, Linux, and many more. Current large online web based systems are mainly written in Unix environments because of their stability, fast multi-programming support and good synchronization layer. A comparison done between two web server systems running dynamic pages on the same hardware; one running Windows NT and the other running Linux kernel 2.0.35, showed that Linux outperforms NT at least 10-1 on complete response time.

The operating system platform that seems to be the most popular among web developers is the Linux Operating System, mainly because it has exceptional support for multi-programming and because it is distributed under the GNU license free of charge. In addition, the file system used under Linux (EXT2) provides extremely fast access for small files typically used with CGI systems and provides a permission layer like all other UNIX operating systems. Linux is a very portable version of UNIX operating systems, and it will run on Sparc, Alpha, Intel as well as many other hardware architectures.

For users that are very concerned with stability and support, Sun Microsystems offers the Solaris Operating System, which will run on both the Sparc and less expensive Intel platforms. Solaris has basically the same native support as Linux although its file system access on small files has been found to be considerably slower.

Finally, Microsoft offers the Windows NT/95/98 operating systems which tend to be significantly easier to administer and more popular for inexperienced users. These platforms are excellent for learning and performing low-end development; however, only at the cost of speed, efficiency and functionality. All the Windows operating systems suffer from poor multi-processing and inter process communication (IPC) support.

System Robustness

When designing large online systems, it is important to consider robustness at five levels:

1) The hardware being used
2) The operating system on the server
3) The web server
4) The CGI programming language
5) Storage used (typically database driven or file system)

One issue that is typically overlooked when deploying large online systems is the server that the online CGI system will be running on. If the hardware on the system (such as the disk subsystem) is not stable, then the system itself cannot be stable. In many places an expensive high end server is not an option. However, a multi-processor Intel based system with SCSI disks and a RAID subsystem can be bought for several thousand dollars as opposed to tens of thousands and yields similar robustness to many high end servers.

There are more questions to ask in relation to robustness. What happens when the system uses up all the memory and how does the operating system deal with this lack of resources? What happens when the CPU load is very high? Some operating systems deal with this problem very well (for example, Linux, Solaris, SCO) while others (Windows 95/NT) tend to crash when resources are used up without hope of recovery.

The web server allows a level of control over client connections, optimizations on connections, and sometimes even program caching. One web server that is very fast, highly configurable and freely distributed under a free license for most operating systems is the Apache Web Server. The server has support for Fast CGI, MOD_PERL, SSL (for secure transactions), keep-alive connections, and many others. Apache can be configured to control the number of clients that connect to control the load on the server as well as do various other optimizations that prove to be very useful in large systems.

The languages mentioned earlier in this paper (Perl, Java and C) all offer methods of fault tolerance and exception handling. One of the largest problems with online systems written in Perl is that it is very easy to write short simple code to attain a goal without making it robust. Perl, unlike other languages, does not enforce strictness. All the languages mentioned offer excellent support for robustness, though it is left to the programmer to enforce these rules.

The storage used by the CGI has a great implication on the continued success and growth of the system. Regular file system storage can be slow, hard to maintain and to synchronize. Databases solve these problems by allowing access to data storage from virtually any language through the use of Standard Query Language (SQL). The most popular databases in the UNIX environments are MySql, PostgreSQL, and Oracle. These databases as well as others can be accessed from virtually any programming language and offer many benefits. MySql and PostgreSQL are both under free licenses and can be used free of charge while Oracle must be purchased but it provides more functionality, robustness and support.

The most important thing in an enterprise/campus-wide information system is its information. Without attention to details of inter-process synchronization, it is easily possible to have situations where some editing changes submitted appear to have been lost, or worse yet, data becomes totally corrupted or deleted. The majority of web applications tend not to consider the full effects of multiple processes accessing data simultaneously.

The first step towards preserving your data integrity is to lock files while they are in use. In Perl and C, this requires using an operating system call, specifically advisory locking (flock/fcntl). This allows multiple processes to read the same file simultaneously, and only one process to access a file while the file is being written.

This type of approach can still be flawed. Consider the following abstract description of a routine:

1. x = Read data from file (while using a shared lock)
2. A large series of changes occur to x.
3. Write x back to the same file (while using an exclusive lock)

An error can occur here when more than one process is simultaneously executing the same piece of code. Assume that two processes, A and B, are both executing the above algorithm, and the order of execution due to process switching occurs as follows:

A executes 1, B executes 1, A executes 2, B executes 2, A executes 3, B executes 3

Only the changes performed by process B take effect, and those changes attempted by process A are lost. For an information system to be reliable, such errors must not be allowed to occur.

The solution to this problem is to allow some form of locking of critical sections. In Java, you can easily use the synchronized keyword. In PERL and C, the best option is IPC. Almost all Unix systems implement System V semaphores. Windows has its own similar synchronization objects, which are accessible from C and PERL.

Now, if the algorithm used above is encapsulated within a critical section block, any process wishing to execute the code will first wait for any other processes executing the same code to finish. This prevents the error discussed above, and if used carefully for any code that can modify a file, will prevent loss of information due to synchronization errors.

Optimization through Memory Caching

Caching is a common method for boosting performance by reading data from internal memory as opposed to always reading it from a much slower hard disk. In complex CGI programs, this can increase performance by up to 10 times by removing the majority of the access to the slow disk device. The negative side effect of using caching is an increase in the amount of memory required [illegible] run the CGI application. With the current low costs of high-speed SDRAM, this expense is almost negligible considering the benefit of the speed increase that can be attained.

Another benefit of caching is rarely considered; namely it also tends to reduce code complexity in an application. In applications which do not use a proper caching system, the method often taken is to use conditional code to determine if a piece of data has already been read during the execution of the program. With a proper caching system, these decisions are performed entirely within the I/O subsystem, and the programmer needs know nothing about the cache.

Effectively, application code changes from this (represented in a flattened fashion):

```
If (!defined($data)) {
    $data = &Read($datafile);
}
... # more code here
If (!defined($data)) {
    $data = &Read($datafile);
}
...
If (!defined($data)) {
    $data = &Read($datafile);
}
...
```

to this:

```
$data = &Read($datafile);
...
$data = &Read($datafile);
...
$data = &Read($datafile);
...
```

Though a trivial example, this code does demonstrate a decrease in the size and complexity of the application code which, in effect, reduces maintenance costs. However, when using caching in a set of concurrent, co-operative processes, synchronization becomes an issue. What happens when one CGI program caches a file, another CGI program loads the same file and changes it, and then afterwards, the first CGI program performs another read on the file? Should the first CGI program read the file from the cache, or from the disk?

A simple approach is to always check the file on the disk on a read operation. If the last modified time of the file is more recent than the copy in the cache, reload it. As well, all writes must be done in a write-through fashion, forcing the caches of all programs to be synchronized through the disk as well as eliminating the possibility of data loss. While this method still does access the disk on all read operations (to check the file modification time), it hides all cache control within the I/O subroutines, and still performs significantly better than using no cache.

Another, slightly faster implementation for CGI programs is to always read from cache if it exists, and not bother checking the file system. To force a reload of a file into cache, a cache item deletion function is called before calling the read operation. This is slightly faster, but tends to be more error-prone and more intrusive on the application's code.

Optimization through Mod_Perl and Apache

On every request, a pure CGI approach typically requires the following steps:

1. Identification of the URL address requested
2. Loading the CGI program
3. Executing the CGI program
4. Unloading the CGI program

In Perl CGI processes, the most time-expensive parts of the request are the loading and unloading of the interpreter and required libraries. Another implication of this process is that any caching performed by the CGI script is lost from one execution to the next even with the same client. There are several solutions proposed to solve this problem. Among the most popular are FastCGI, Servlets and Mod_Perl.

FastCGI is a method whereby the first time a CGI is loaded, it remains resident. Subsequent requests for the CGI only execute the program, and do not have to load or unload the interpreter. This increases the efficiency of the application by orders of magnitude. Various groups benchmark the performance increase as being anywhere from 400% to 2000%, depending on the application.

A similar concept is Java Servlets. Essentially, the same action is performed. The Servlet is loaded the first time its URL address is requested. Thereafter, it is not loaded or unloaded from memory; it is only executed. The observed performance difference is similar.

Mod_Perl is a pluggin to the Apache web server, which is similar to the above two approaches except that it is limited to CGI's developed using the Perl programming language. It has a similar performance improvement, but has two additional advantages:

1. It can over-ride any phase of the web server process. Effectively, you can use Mod_Perl to write customized authentication routines, URI-to-function mapping, and other useful functionality.
2. It embeds the Perl interpreter directly inside the Apache web server executable. This is beneficial for scalability on multi-processor machines because context switches are not required between phases of the web server. As well, actual Perl library and CGI script code caching is done so that code can be executed directly in internal memory without the need to load it from disk.

Because of its many advantages, Mod_Perl was used in the implementation of newer versions of the ACME system and is growing in popularity for large online systems.

With the use of Mod_Perl, cache items loaded from disk in one script can still be in the cache when the next script executes in the same web server process. This increases the effectiveness of caching, because files can be cached for an even longer period of time. This on its own increases the performance of a Mod_Perl application greatly.

System Scalability

Many online CGI systems are designed for a limited number of people, and are certainly not scalable to hundreds or even to thousands of users. The main problem with scalability is the lack of centralized data storage. When the load on a system becomes too high, it is often necessary to introduce multiple servers to split the load of the online system. The two most common ways to deal with multiple servers having to use shared data is to use databases or Remote Procedure Calls (RPC).

Databases offer the best way to implement shared data across multiple servers. They take care of all the synchronization and data can be accessed by standard SQL statements. The problem with databases is that often developers do not want to take the time to learn database specifics on top of the operating system and programming language. An alternative is to use the abstract concept of RPC on top of the operating TCP/IP layer. This approach allows creating a single RFC based data server on a dedicated server that all other CGI based systems can communicate with. The Data Server can compensate for speed lost due to network transfers by gaining performance from efficient caching of data structures. The disadvantage to this approach is the lack of standards to communicate with the data server and the efficiency lost due to data marshalling that is done internally by the RPC client and server. The data server can easily handle synchronization because of its unified nature. It also provides additional optimization by using threading without the need of forking "heavy-weight" processes to deal with each data request as servers typically do.

Conclusions

Because of many of the factors discussed in this paper, our own current choice of implementation is on a Unix system (production systems exist both on the Solaris and Linux operating systems), using the Apache web server with the Mod_Perl module, and RPC for distributed processing, though we are moving to a traditional Relational Database Management System (RDBMS) storage scheme.

To answer the requirements of a web-based enterprise solution, the methods discussed above, while not exhaustive, have been found to be very effective. Not surprisingly, many of the techniques for developing enterprise-wide WWW systems are very much the same as those used in traditional client/server application programming which tend to be ignored in WWW development: choice of language; choice of platform, design for performance, design for robustness, and design for scalability.

References

Arnold, K. Gossling, J. (1998) *The Java Programming Language*, Second Edition. Addison-Wesley.
D. Robinson, *The WWW Common Gateway Interface Version 1.1*
Goldberg M. W., Salari S and Swoboda P. (1996) *World Wide Web Course Tool: An Environment for Building WWW-Based Courses*, Computer Networks and ISDN Systems, 28.
HTML: The Definitive Guide, (1994). O'Reilly and Associates.
HTTP (1998). http://www.w3.org
Johnson, Eric. (1996). *Cross Platform Perl*, M&T.
MySql Database. http://www.mysql.org
Oracle Database. http://www.oracle.com
Postgresql Database. http://looking-glass.usask.ca/postgresql/
Rodden, T. (1996). *Populating the Application: A Model of Awareness for Cooperative Applications*. In Proceedings of ACM CSCW'96 Conference on Computer-Supported Cooperative Work, Cambridge, MA.
Sun Microsystems. http://www.sun.com
The Apache web server. http://www.apache.org
The Automated Courseware Management Environment at Acadia University: http://acme.acadiau.ca
The Java programming language. http://www.javasoft.com
The Linux Operating System. http://www.linux.org
The Perl - Apache integration project. http://perl.apache.org
The Perl Programming language. http://www.perl.org
Web Course In a Box. http://www.madduck.com/webinfo/web.html
Web Course Tools. http://www.webct.com

An Experiment with Computer-Supported Cooperative Work: Shared Workspace

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1 Introduction

With the increased availability of the Internet, personal computers and fast networks, there are many research efforts directed at teamwork, interactions, and in general, asynchronous and synchronous collaboration. The main focus of these efforts is to explore the possibility of fully integrating computers into the classroom, and not just on a single computer-per-classroom basis. Another reason for the interest in this research is the growing number of universities, which have built fully computerized campuses. For example, Acadia University, see [MacDougall et al. 1998, and Tomek et al. 1999] has been involved in building such a campus; it provides fast network connections for all students living on the campus as well as electronic classrooms (a setting in which every student and the teacher have access to a personal computer, and all the computers are networked see [Shneiderman et al 1995]), allowing for various types of computer-supported interaction. Computerization of a campus is a very expensive operation and it has to be proven to be cost effective. While hardware for the above initiative is readily available, there seems to be a lack of software that takes advantage of these hardware facilities and at the same time is known to be useful in learning and teaching. Groupware or computer-supported cooperative work (CSCW) refers to computer-based systems that provide an interface to a shared environment in order to support groups of people working towards a common goal, see [Grudin 1994, Norman 1996]. A related area, Collaborative Virtual Environments, CVEs is also getting a lot of interest, see for example [West et al 1998]. However, most CSCW systems do not support the creativity of a *group*, in particular they do not support procedures to achieve a goal or create a common plan. There is a significant difference between *cooperation* and *collaboration*. In a cooperative process, members of the group interact and exchange their individual ideas, and as a result, they come to understand each other. In a collaborative process, members of the group work together to *create* something new. The group can switch back and forth from one mode to the other. For more details of a group-thinking model, see [Nishimoto et al 1998].

This paper describes the design and implementation of a prototype environment, called a Shared Workspace in which information can be shared and acted on in collaboration with other users in an electronic classroom – a shared workspace as described in [Müldner & Nicholl 1996]. The system is built around a client-server architecture with the environment, called a workspace, supported by a server to which the client connects and with which the client interacts. Users can share files by making them available on their server for download by other users. Additionally, users may participate in multi-user editing sessions on files, where several users interact and negotiate with each other as they collaboratively edit a document. Each student in the electronic classroom is expected to have a computer on which a workspace resides; the instructor is also expected to maintain a workspace. Students can connect to other students' workspaces in order to share data and interact with each other. The file transfer facilities could be used in and out of the class to distribute course-related material from the instructor to the student, or to send assignments or solutions from the students to the instructor. Shared editing is useful in certain classroom interactions, particularly in situations where a piece of text, such as a block of program source code, is being discussed by the class. Here, we do not limit the scope of our discussion to "physical" classrooms in which the teacher and students share the same room; i.e. we consider both synchronous, face-to-face systems, and distributed asynchronous, virtual classrooms as used for example in distance education. In addition, we assume that each user can work on-line (connected to the network), or off-line.

This paper is organized as follows. Section 2 gives a general description of a distributed information system and introduces the basic terminology; and Section 3 discusses the Shared Workspace, and provides a brief description of the implementation. Finally, in Section 4, we describe our experience using SW.

2 Distributed Information Systems

A survey of the available literature for the term distributed information system (DIS) will likely turn up definitions ranging from distributed computation to distributed databases. On one end of the spectrum is distributed computation, where processing is distributed across multiple processors. Data is either distributed to optimise processing time, or is accessible as a shared resource [Booth 1981]. On the other end of the spectrum are distributed databases, in which the system consists of distributed data, with various services offered, which may or may not be distributed in nature. Both of these definitions require that the machines that do the processing or store the data are all connected by some kind of network.

A definition that seems to strike a middle ground is that a *distributed information system* is a system where information and functionality are distributed across multiple machines connected by a network. These systems are useful to us for various reasons. The most obvious one is that by summing the collective storage and computational power of multiple computers, we obtain a potentially more powerful system that can do the job of multiple computers. Additionally, with the duplication of resources the redundancy could mean that the failure of one component would not imply the failure of the system as a whole. Thus, distributed systems provide parallelism and fault tolerance, making them potentially much more powerful than their individual components [Mullender 1989].

2.1 Information Sharing

The most basic thing we want to be able to do is to exchange and share information. The system described above is similar to a Cooperative Information System, CIS, see [Papazoglou 1992]; but we do not assume any "intelligence" of the system; for example that it can actively reason about the information it contains and search for these pieces of information by connecting to other systems. Instead, we assume that the user takes this role. In addition, we consider only *homogenous* data sources; i.e. two information systems are assumed to be "similar". In order to describe the above task (exchanging and sharing information), we consider two kinds of applications, here called respectively providers and fetchers. A *provider* application gives access to available information for authorized users; a *fetcher* application is designed to fetch or browse information from one or more providers. Typically, a provider is implemented as a server, and a fetcher as a client; for more information about clients and servers, see [Mullender 1989]. However, they can also be implemented using software agents, see [Huhns 1998]. Note that a single application may be both a provider (server) and a fetcher (client) at the same time, and that it can change its role, for example by switching from a providing mode to a fetching mode. The two modes described above; i.e. those of providing information and of fetching information may not be enough to provide satisfactory functionality; sometimes one would like to be notified when a certain event occurs. Thus, we add a *notification system*. A fetcher can request information in the event that it finds the required information is not available or it just wants to have up-to-date knowledge of the information system; for example when new information becomes available (addition notification) or is changed (change notification). This model is based on the concepts of "information pull", where users are constantly trying to pull some information, and "information push", where the system tries to push information. Note that information push systems may be profile-based, or context- and situation-based; see [Van de Velde at al. 1997]. Our model assumes that the users are active; i.e. they use the fetcher applications to obtain the required information. An alternative would be to consider active, autonomous providers, such as software agents, using planning to search for the required information; see [Huhns 1998].

It is not realistic to expect that the provider would like to make all its information available to all other users. Therefore, for each piece of information there is an associated list of users and their passwords, and the fetcher has to go through an authentication process before it can fetch information from the provider. A particular fetcher may have various permissions with regards to a piece of information; such as view, traverse, copy, or permissions related to notifications. To accommodate this process, groups of users can be created and specific permissions may be assigned to an entire group.

Probably the largest DIS in existence today, the World Wide Web (WWW) is a global network of servers, which distribute heterogeneous data to various clients. The Hyper-G system and its commercial successor, Hyperwave, see [Maurer 1996] solve the structural problems of the WWW by using bi-directional links, and improve on coherence with a more structured method of composing information structures.

Is sharing data between users enough? Consider as an example a specific class for teaching programming in the C programming language, taking place in an electronic classroom. At the beginning of the class, the instructor (provider) makes available an example (a file) of a program in C to all students in the classroom. (As an alternative, the instructor may prepare several examples and divide students into groups by giving each group a different example.) Now, the students can download this file to their computers. They can view and modify this file, they can make new versions of this file and make these versions available to all students, or specific students. However, there is little real-time interaction in this activity; for example the instructor may wish to make a file available for viewing only (no downloading) and share the *execution* of a specific program (for example, an editor) with all students. Thus, the next section describes execution sharing.

2.2 Execution Sharing

Execution sharing is not the same as "distributed execution", where various actions involved in the execution take place on different host computers. What we mean by *execution sharing* is a set of users (of networked computers) which simultaneously execute a single application (are involved in a session). Users can join and leave the session. Non-interactive applications are not very interesting; we are more interested in applications that interact with the user and require some form of input. Since a typical application accepts input from a single user, we will say a *controller* is the user who currently provides this input; and a *ghost* is any non-controller user that has a read-only view of the running application. Collaborative environments use a *floor control mechanism* in order to prevent contradictory events [Hilt and Geyer 1997]; hence a controller has control of the floor. When we consider a shared (in the sense of the above definition) editor, then we can easily convince ourselves that it is useful to have exactly one controller; otherwise simultaneous events may lead to confusion. However, for other applications it makes sense to consider multiple controllers; for example in a typical chat room every user is a controller. Now, who is the controller? To answer this question, let's concentrate for a moment on the example of a shared editor. One may assume that the owner of a file is the controller; he or she would start an editing session while other users would be viewing the modifications on the edited file. There are two problems with the above definition. The first problem arises when the controller wants to pass the floor to another user (thereby giving up control of the floor); for example the instructor showing a C program may want to designate a student to remove syntax errors from the program. For this reason, we distinguish between the owner of resources involved in the execution (for example, files) and the controller of the session. The session is started by the owner, who at that time is also the controller of the session. Next, with each session we associate a token, which originally belongs to the owner and is always held by the controller. Note that the controller can pass the token to another user who then becomes the controller. Actually, one may consider different types of *token policies*; one type of a policy would force the user who gets it to later on return it to the provider; another type of a policy would allow the controller to pass the token on to another user. In any case, the owner of a token will have the right to revoke a token from the controller. Here, the owner of the token is the owner of the session. The second problem with the above definition is that while it may be satisfactory for synchronous sessions, it doesn't provide the required functionality for asynchronous sessions. For example, consider a moderated discussion group and a moderator who is not currently available. The moderator may then wish to give all held privileges (including that of revoking) to another user. To solve both these problems, we assume that a token has various attributes, such as "permission to forward". Now, let's consider in more detail what passing a token to another user means. Logically speaking, another user starts controlling the application. One possible implementation would involve saving the state of the execution (data), and passing the entire application with this state to a new controller. This technique is used to implement software agents, see [Huhns 1998]. For applications such as editors, it is easy to save the state of the execution, because it does not involve saving the execution stack, and so can be accomplished even if the underlying language, such as Java, does not give access to the run time information. Finally, let's describe how the controller makes a decision as to who gets a token. In a virtual world, there is a need for some type of communication associated with a shared session. For example, to allow the controller to ask: "Who is ready to correct a syntax error in this program?" and then make a decision based on a request list; i.e. a list of users who "raised their hands" (applied for control of the floor) to indicate their readiness.

Small DIS's span only a few machines and perform more specialized functions. One such system is NetMeeting, see [Microsoft 1998], that attempts to support group activities by providing various forms of computer-aided communication, collaboration and data sharing functions. A simple file transfer facility also allows users to share files. Unfortunately, NetMeeting provides a very rudimentary floor control and therefore is not useful for most CSCW applications. The shared workspace, described in more detail in the following chapters, contains a few elements from DIS's described above, but, like NetMeeting, is designed for smaller group interactions.

3 Shared Workspace

3.1 System Functionality

Shared Workspace (SW) is a centralized (residing on a single machine) information system, providing file transfers and shared editing services. Each user of SW is both a provider (server) and a fetcher (client); no notification system has been implemented. To the system, each user is identified by a username, with an associated password, used for authentication when a user attempts to fetch files from other users' workspaces. Each SW maintains its own list of (username, password) pairs. Users in SW move between file areas (described below) and interact with files and possibly other users as a result of file interactions.

For each file there is an access list of users that have permission to perform some operation on that file. By default, the owner of a file is a member of its access list. These access lists are an extra attribute imposed on the files already in the file system, and it is not presumed that all files on a file system will have an access list. Accordingly, when a file with no access list is accessed, it will be assigned the default list with the file's owner as its only member, meaning that only the owner of that file will have access to it. In order to make the file accessible to others, the owner will have to explicitly alter its access list. In order to facilitate provision of files that can be downloaded (fetched), we introduce a file area; a functional unordered collection of files. They are *functional* because file areas define the actions, which may be performed on a file area's contents. A file's access list is identical across file areas, implying that the same set of users will be able to perform the same set of actions on a file spanning multiple file areas. Actually, SW maintains two file areas: the 'download' area and the 'editable' area, and users are only allowed to directly transfer files from the download area, while only files in the editable area can be opened for editing. If a file is in the download area and the editable area at the same time, then it is downloadable and editable by the same set of users.

Each entity in a shared workspace is subject to restrictions on the actions which users may perform on it. Access restrictions are defined by ownership and access lists. The owner of an entity can alter its properties, e.g. access lists. By default, the creator of an entity is also its owner, but ownership may be passed to another user, or relinquished, meaning the entity would have no owner (in that case it is accessible at all levels to all users on the system). A user on an access list is not allowed to alter the entity's access list. The accessibility of an entity on the system can be defined in terms of ownership and access lists at three levels:

Accessibility	Owner	Access list
1. Full public	None	Empty
2. Restricted public	User	Empty
3. Restricted	User	Non-empty

If an entity's accessibility is full public, all users in the system may access the entity with no restrictions whatsoever. Once an entity has an owner, however, its accessibility is reduced to "restricted public", meaning that only the owner may alter the entity's properties, while other users may perform less sensitive operations on it, such as editing the entity if it is a file. Specifying an access list for an entity completely restricts the entity's accessibility, explicitly specifying the set of users that may perform non-sensitive operations on the entity.

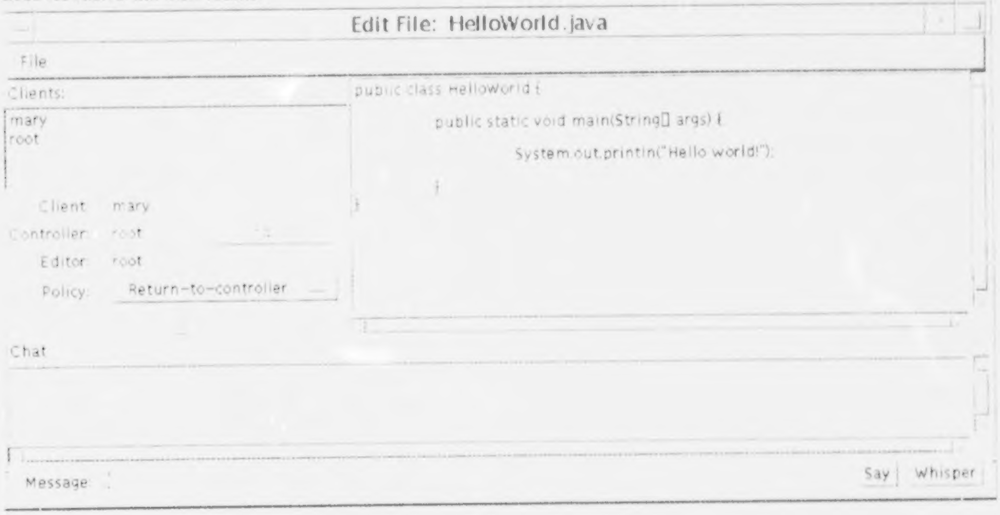
3.2 Editing Sessions

SW provides asynchronous write access to a document through the use of a token-passing scheme. An editing session may be created by any user who is a member of the access list of a file in an editable area. Subsequent users who enter that file area may join a running editing session, provided they are also members of the relevant file's access list. The controller role is defined in a session, and the role is filled by a user, who is, by default, the creator of the session. The role of the controller is not restricted to the creator of the session, and the current controller may pass the role to other users. A controller is responsible for the following operations in the session: closing the session, choosing a token-passing policy, revoking the token, and passing the role of controller to another user. A token is associated with an editing session in order to control access to the document being edited. A user must possess the token in order to make changes to the document. After the desired changes have been made, the user may relinquish the token under the rules of the current token-passing policy. The following policies are currently available:

- Return-on-completion: The user returns the token to the controller upon completion
- User-choice: The user passes the token to another user (of their choice) upon completion
- Open-choice: Upon completion, the token is open for any user to take.

Additionally, the controller may revoke the token at any time during the session. The file being edited may be saved locally on a user's machine during the course of an editing session. Only the owner of the file may permanently alter the original file being edited. This is accomplished by locally saving the file over the original file; essentially replacing the original with the newly edited version. It is difficult to perform any collaborative activity without communication, so a chat area is created as part of the editing session. This chat area functions much like channels in the Internet Relay Chart (IRC); members of the editing session post messages to the chat area, which is seen by all members of the session. Additionally, users may 'whisper' to each other, i.e. send a message directly from one user to another.

A screen dump shown below demonstrates an editing session in which the root is the controller, the current token policy is "return-to-controller". Mary is the user presented with the edit window with the text area disabled (gray), as she does not have the edit token:



```
public class HelloWorld {
        public static void main(String[] args) {
                System.out.println("Hello world!");
        }
}
```

Clients:
mary
root

Client: mary
Controller: root
Editor: root
Policy: Return-to-controller

Message:

The implementation is based on Java Remote Method Invocation (RMI), see [Sun Microsystems 1997], which provides a semi-transparent means for clients to access remote objects. The use of the Common Object Request Broker Architecture (CORBA), see [Object Management Group 1998] was considered as an alternative to RMI during design, but Java's built-in support for RMI provided an easier implementation. In an environment such as Acadia University, where the majority of students use laptop computers, special problems occur. A laptop computer is assigned a dynamic IP address on the network, which changes as the computer is moved from one network subnet to another. The solution implemented was to mimic a domain naming service, by providing a simplified Java RMI based naming service that maps user-defined names to dynamic IP addresses. A workspace, when first created, registers a user-defined name with the naming service, which is run on a computer with a static IP address. Subsequently, when the workspace server is activated, it must inform the naming service of its current dynamic IP address. When a server goes off-line, it informs the naming service as well. The shared editor described is implemented using the Java Shared Data Toolkit (JSDT), see [Sun Microsystems 1998] which defines a simple collaborative toolkit providing support for session-based collaboration.

4 Conclusions and Future Work

An evaluation of the usefulness of SW in electronic classrooms (its target audience) reveals deficiencies and issues at several levels, including the file system, shared editor, and distribution strategy. While the shared editor in general

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is useful in a classroom setting, its chat function, if used, could hinder interaction. Imagine an entire room of students sitting in a room staring at their screens, and not paying any attention to the instructor, since all communication is handled through software! The problem arises, of course, of trying to attract the instructor's attention while he or she is busy typing into the editor. Using a chat function in such a situation might seem justified (particularly for a virtual classroom), but this problem is no different from that of an instructor writing on a blackboard with his or her back turned to the class. Hence, the chat function is only useful in the context of a virtual classroom.

The distribution strategy used in SW requires that all users be clients and/or servers. In order for a file to be transferred from one user to another, the sender must be a server, while the recipient must be a client. A totally connected system is thus impractical, since it would require n^2 connections, where n is the number of users. The simplest scheme that might be of use in a classroom would be that of the instructor's computer acting as the only server for all the students in the classroom during the duration of a class, but this lacks flexibility in the event that students need to transfer files amongst one another, which may be required in group work. The setup and possible teardown of client-server connections between students in a group at the start of each meeting would be tedious at best.

Acknowledgments

Most of the work described in this paper has been done as a part of the honours thesis written by the second author of this paper (completed in September, 1998).

References

[Booth 1981] Booth, Grayce M. *The Distributed System Environment.* New York: McGraw-Hill, 1981

[Grudin 1994] Grudin, J. Groupware and Social Dynamics: Eight Challenges for Software Developers; *Communications of the ACM*, 37, 1 (1994), 93-105.

[Hilt & Geyer 1997] Hilt, V. & Geyer, W. A Model for Collaborative Services in Distributed Learning Environments. In: *Proc. IDMS'97*, Darmstadt, LNCS 1309, 364 -375.

[Huhns 1998] M.N. Huhns. Agent Foundations for Cooperative Information Systems. In: *Proc. s of the Third International Conference on the Practical Applications of Intelligent Agents and Multi-Agent Technology*; London 1998; Edited by H.S. Nwana and D.T. Ndumu.

[Macdougall et al 1998] Macdougall, G., Müldner, T. and I. Tomek. Computerized Campus. *Edmedia'98*, Freiburg, 1998.

[Maurer 1996] Maurer, H. *Hyperwave: The Next Generation Web Solution.*, Harlow, England: Addison-Wesley. 1996.

[Microsoft 1998] Microsoft Corporation. *NetMeeting Home.* [On-line]. Available: http://www.microsoft.com/netmeeting/

[Mullender 1989] Mullender, Sape. *Distributed Systems.* New York: ACM Press, 1989.

[Müldner & Nicholl 1996] Müldner, T. and Nicholl, R. A. Computer-Supported Human Cooperation in Electronic Classrooms. *Journal of Universal Computer Science.* 2(10), 1996.

[Nishimoto et al. 1998] Nishimoto, K., Sumi, Y., Kadobayashi, R. and Mase K. Group Thinking with a Multi-Agent Architecture. In: *Proceedings of the Third International Conference on the Practical Applications of Intelligent Agents and Multi-Agent Technology*; London 1998; Edited by H.S. Nwana and D.T. Ndumu.

[Norman 1996] Norman, D.A., Spohrer, J.C. Learner-Centered Education; *Communications of the ACM*, 39, 4 (1996), 24-27.

[Object Management Group 1998] Object Management Group. *The Common Object Request Broker: Architecture and Specification.* [On-line]. Available:ftp://ftp.omg.org/pub/docs/formal/98-07-01.pdf (17 September 1998).

[Papazoglou 1992] Papazoglou, M.: An Organizational Framework for Intelligent Cooperative IS. *IJICS-1* (1). 1992.

[Shneiderman et al 1995] Shneiderman, B., Alavi, M., Norman, K. and Borkowski, E. Windows of Opportunity in Electronic Classrooms; *Communications of the ACM*, 38, 11 (1995).

[Sun Microsystems 1998]. Sun Microsystems. *The Java Language Environment.* On-line. http://www.javasoft.com/docs/white/langenv/

[Sun Microsystems 1997] Sun Microsystems. *Remote Method Invocation Specification.* On-line. Available: http://www.javasoft.com/products/jdk/1.1/docs/guide/rmi/spec/rmiTOC.doc.html (11 September 1998).

[Sun Microsystems 1998) Sun Microsystems. *Java Shared Data Toolkit Technical Information.* On-line. Available: http://java.sun.com/products/java-media/jsdt/techinfo.html (11 September 1998).

[Tomek et al. 1999] Tomek, I. and T. Müldner. Acadia Advantage - Evolution and Experiences; accepted for: Special Issue "Faculty change & the WWW". *Journal: Interactive Learning Environments.* Swets & Zeitlinger Publishers.

[Van de Velde at al. 1997] Van de Velde, W., Geldof, S. and Schrooten, R. Competition for Attention. In: Intelligent Agents IV. Agent Theories, Architectures and Languages. *Lecture Notes in Artificial Intelligence* 1365; J.G. Carbonell and J. Siekmann (Eds.) Lecture Notes in Computer Science; Springer Verlag 1997

[West et al 1998] West, A. and Hubbold, R. Keynote Speech, *Collaborative Virtual Environments'98*, Manchester, June 98.

Distributed Marking System: CORBA Implementation

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1 Introduction

Maintenance of student assignments is an important part of everyday routine of all instructors. Traditionally, assignments are prepared by an instructor in paper form, and then given to students. When student solutions are collected, they are given to markers who upon marking update student mark files and return marked assignments to students. With the advent of computerized campuses, there have been various attempts to use computers to automate some of the tasks described above. In this paper we describe a general, integrated, and Distributed Marking System, DMS which can be used to post assignment descriptions and submit solutions, mark solutions using specialized marker tools, and maintain student marks using a file system or database. Our main goal was to design a system which is user friendly, distributed, and extensible. For a system to be user friendly, our design uses specialized graphical user interfaces, GUIs. These GUIs are custom made for various kinds of users; and will appear different for students, markers and instructors. DMS consists of a server and a number of clients, and is fully distributed so that users can connect from networked computers. However, DMS supports not only pulling information such as an assignment outline, and online access such as displaying marks or outlines but also pushing information on to a client's machine so that she or he can work off-line (for example, to mark an assignment, the marker does not have to be connected to the network). Off-line work is particularly useful if the system is flexible and extensible; for example a marker should be able to use various specialized marking tools, implemented in different programming languages. We do not wish to limit ourselves to specific hardware or an operating system; for example we want to be able to accommodate a student who uses Unix on a PC, and a marker using a Macintosh. For this reason, we are using Common Object Request Broker Architecture, CORBA that extends the reach of our applications across networks, languages, component boundaries, and operating systems, (see [Object Management Group 1998]). While the current version has been written in Java (see [Sun Microsystems 1998]), any client or even the entire server could be written in any programming language, for example C++ or Smalltalk, and run under any operating system on various hardware platforms.

Why have we chosen Java rather than another language? A standard web browser is extended with a Java runtime, and it can automatically download an applet to the user's host computer and execute it there. This feature provides a simple and flexible mechanism for transferring executable software to users when it is actually needed, instead of installing it at their host or site ahead of time. Therefore WWW infrastructure and Java applets can simplify the job of deploying the user client components of a distributed application; something hardly possible with other languages; see: *http://www.arlut.utexas.edu/~itgwww/ird/JavaCORBA.html*.

Since maintenance of student files is an important part of any marking system, we designed a flexible interface that can be used to store marks, users, courses and assignment information in a file system, or through Java Data Base Connection, JDBC in practically any available data base. Therefore, DMS is designed as a 3-tier application where we have a thin-client, middleware and a database.

Clearly, only authenticated users should be allowed to use a marking system. Therefore, a "super-user", who creates student, marker and instructor password-protected accounts, administers DMS.

Other available marking systems, for example the one described in [Pillaipakkamnatt, Wilkins 1998], do not provide the same functionality, flexibility and extendibility. For example, the latter system does not support off-line activities, or use of arbitrary implementation programming languages.

The rest of this paper is organized as follows. Section 2 describes assignment maintenance; Section 3 shows interfaces for various users, and Section 4 briefly describes the design and the implementation. Finally, Section 5 discusses future extensions.

2 Assignment Maintenance

DMS provides one central server, and a number of clients (see below). Let's first identify the basic activities in the assignment maintenance process, as well as actors involved in this process:

Hand-out: Assignment outline is provided by the *instructor*
Hand-in: Assignment solution is provided by every *student*
Marking: Assignment solutions are marked by the *marker*
Return: Marked solutions are returned by the marker to students.

Since every user involved must be properly authenticated by the system, she or he has a password-protected account, and therefore we provide one more type of an actor; a *super-user* who is the only user allowed to create, modify and remove accounts. Since there are four types of actors, we have four types of client applications. For a hand-out activity, the assignment outline is uploaded to the DMS server, and it is downloaded from the server to the student's machine. For a hand-in activity, an assignment solution is uploaded by the student to the server, and downloaded by the marker from the server. For a return activity, marked assignments are uploaded by the marker to the server, and then they can be downloaded by the student. (See below for detailed descriptions of different actor interfaces.) Note that the network connections are minimized, and used only when necessary. As soon as the process of uploading or downloading is completed, the user can work off-line.; in particular, the marking activity requires no network connection.

Every actor can communicate with DMS through what we call here a dms-let, which can appear in one of two ways; as a Java applet (dms-applet) or as a Java application (dms-application). Therefore, there are four types of dms-lets, one for each type of an actor; and every dms-let can be an applet or an application. Using an applet the actor merely requires a web browser and does not have to go through the installation process. However, in some cases this applet has to be able to access the user's file system. For example, the student's dms-applet has to write to the student's machine when an assignment outline is to be downloaded; and it has to read from the file system when an assignment solution is to be uploaded. Therefore, we use digitally signed applets, see [Java Applet Security 1998], which provide a secure way of giving applets access to the local machine file system. Unfortunately, with signed applets client start-up is slow, since every time all of the client applet classes need to be downloaded from the WWW server, and so the user may choose instead to use a dms-application; see [Fig. 1]. DMS provides a convenient way of deploying dms-applications; which requires a single step using any browser to point to the DMS home page, download this application and install it on her or his machine. In addition, the design described above allows for easy updates of any dms-application; update is transparent for dms-applets, and the dms-application user connecting to the DMS server can be informed that she or he should download the newer version of this application.

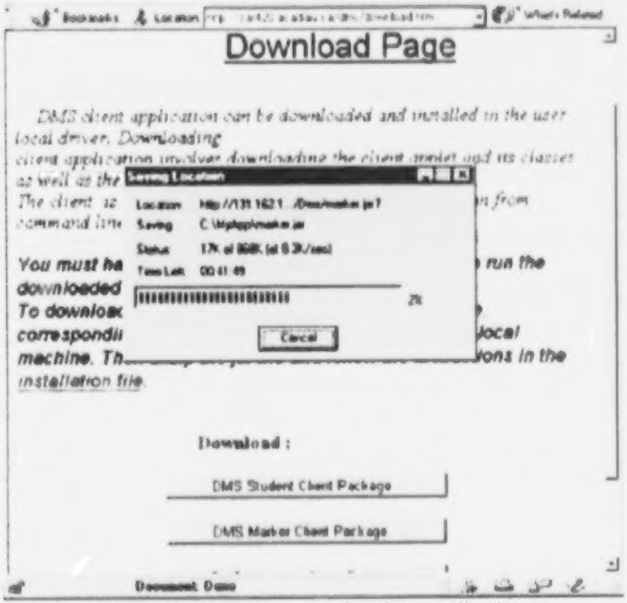
3 Interfaces

3.1 Super-User

The super user can carry out the following activities; see [Fig. 2]:

- create, delete and modify user (instructor, marker or student) accounts
- create, delete and modify course accounts
- register and drop courses to and from user accounts.
- set client connection time to limit server overload
- purge or archive old submissions and limit file sizes for submissions.

Courses may be taught by more than one instructor or marker. The super user assigns instructors to courses. Markers are initially assigned by the super user but instructors can modify them at any time.


Bookmarks
Location
What's Related
Saving Location
Cancel
Document: Done

Download Page

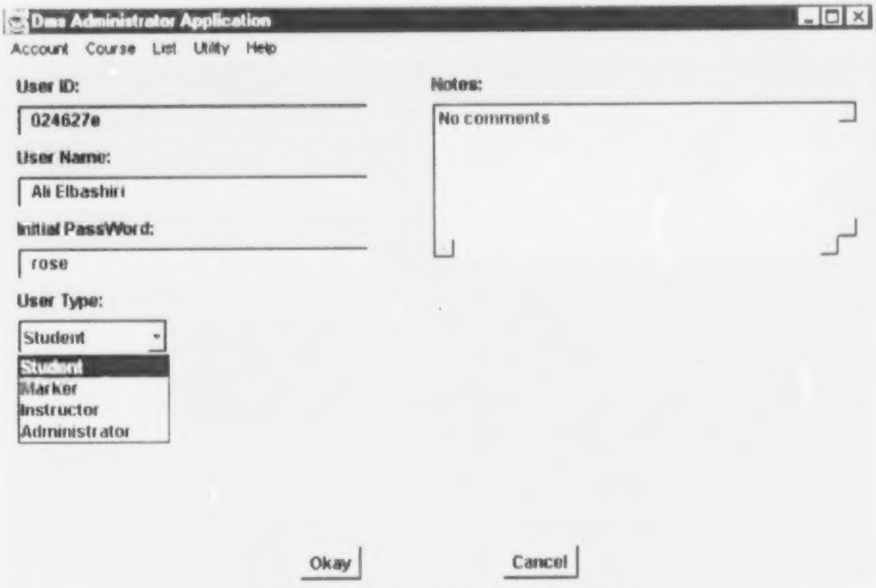
DMS client application can be downloaded and installed in the user local driver. Downloading
client application involves downloading the client applet and its classes as well as the
The client ... from command line

You must ha... run the downloaded
To downloa...
correspondi... local machine. Th... ions in the installation file.

Download :

DMS Student Client Package
DMS Marker Client Package

Figure 1: Deploying a Marker dms-application.


Dms Administrator Application
Account
Course
List
Utility
Help
Student
Marker
Instructor
Administrator
Okay
Cancel

User ID: 024627e

User Name: Ali Elbashiri

Initial PassWord: rose

User Type: Student

Notes: No comments

Figure 2: Super user maintains user accounts.

3.2 Instructor

The instructor can prepare an assignment description off-line or on-line; see [Fig. 3]. Assignment descriptions must be loaded in a text format so that it can be viewed on-line on the user GUI text area. To prevent instructors from

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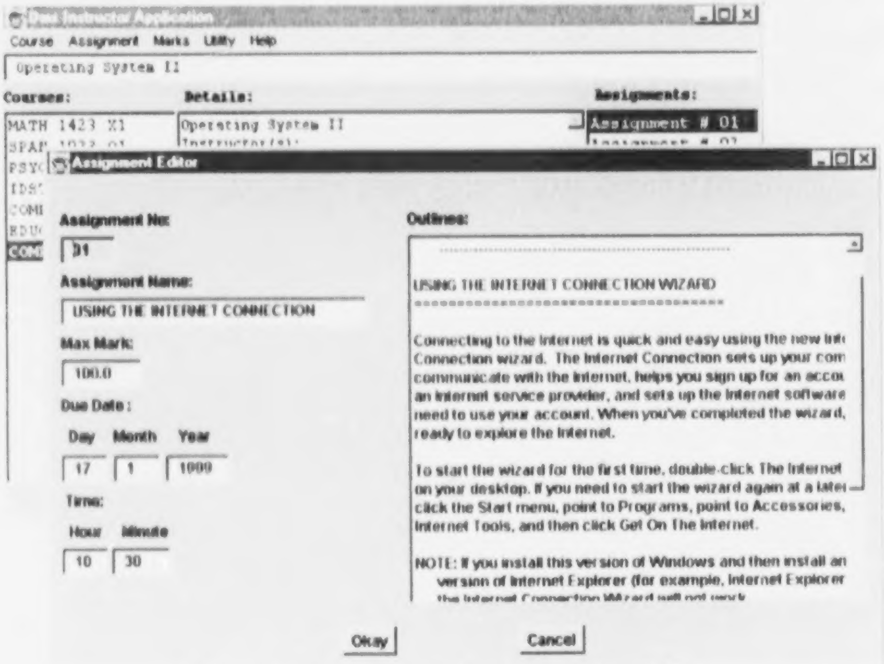
uploading files that are not in text format, we limited their off-line option, and only a cut/paste technique for uploading assignment descriptions can be used.


Dms Instructor Application
Course Assignment Marks Utility Help
Courses:
Details:
Assignments:
Assignment Editor
Okay
Cancel

Operating System II

MATH 1423 X1

Operating System II

Assignment # 01

Assignment No: 01

Assignment Name: USING THE INTERNET CONNECTION

Max Mark: 100.0

Due Date: Day 17 Month 1 Year 1999

Time: Hour 10 Minute 30

Outlines:

USING THE INTERNET CONNECTION WIZARD
======================================

Connecting to the Internet is quick and easy using the new Inte
Connection wizard. The Internet Connection sets up your com
communicate with the Internet, helps you sign up for an accou
an Internet service provider, and sets up the Internet software
need to use your account. When you've completed the wizard,
ready to explore the Internet.

To start the wizard for the first time, double-click The Internet
on your desktop. If you need to start the wizard again at a later
click the Start menu, point to Programs, point to Accessories,
Internet Tools, and then click Get On The Internet.

NOTE: If you install this version of Windows and then install an
version of Internet Explorer (for example, Internet Explorer

Figure 3: Instructor submits the assignment description.

3.3 Marker

Marker downloading assignment solutions is shown in [Fig. 4]. The left-hand side column is generated based on courses currently marked by this marker. Once a specific course is selected (MATH 1423 X1), the description of this course appears in the center column, and those assignments for this course appear in the right-hand column A specific assignment can be chosen by selecting it (Assignment 02 above); a brief information about this assignment is appended to the central column. The Download menu provides two items, used respectively to download assignment outlines, and some or all assignment solutions.

Marker can not download solutions that have already been downloaded. Courses may have more than one marker so it is left to the markers to divide the solutions among them. Solutions will be saved in the marker drive as a tree-like structure, starting with root directory (the course name), student name and the assignment name.

Once the assignment solutions are downloaded, the marker can disconnect from the network and at her or his convenience, and mark assignments off-line. For this sake, specialized marking software can be used (not available as a part of the current version of DMS). For example, a single programming assignment in C may consist of many files, but is submitted as a single jar file. This file will include the "packing information"; for example, under Unix it may be required that the assignment source files come with the `make` program. This packing information and other specifications can be specified for each assignment by the instructor and be available for the marker to download as a text file. Therefore, we need a *preprocessor* that retrieves and accordingly unpacks the assignment (for the above Unix scenario, it will use `make` to create executable code). The preprocessor may also run the executable code against test input data, if provided, and inform the marker about the results of these runs. Then, an editor would allow the marker to choose a course to mark, and then move from one solution to another by simply selecting a menu item. Marks are automatically maintained and stored in a form suitable for upload to the DMS server. A menu item provides standard deductions that can be customized for each assignment (for example, -10% for wrong indentation). The marker can annotate the student's solution using appropriate comments.

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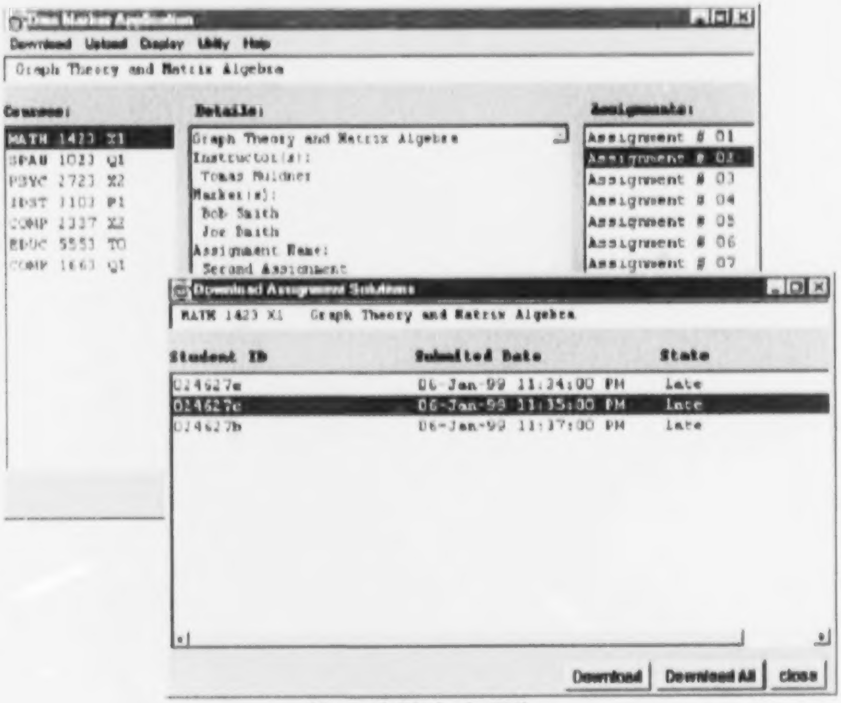

Graph Theory and Matrix Algebra

MATH 1423 X1
SPAN 1023 Q1
PSYC 2723 X2
HIST 1103 P1
COMP 2337 X2
EDUC 5553 TO
COMP 1663 Q1

Graph Theory and Matrix Algebra
Instructor(s):
Tomas Muldner
Marker(s):
Bob Smith
Joe Smith
Assignment Name:
Second Assignment

Assignment # 01
Assignment # 02
Assignment # 03
Assignment # 04
Assignment # 05
Assignment # 06
Assignment # 07

MATH 1423 X1 Graph Theory and Matrix Algebra

Student ID	Submited Date	State
024627e	06-Jan-99 11:34:00 PM	Late
024627c	06-Jan-99 11:35:00 PM	Late
024627b	06-Jan-99 11:37:00 PM	Late

Figure 4: Marker's GUI.

When marking is completed, the marker moves to the next solution, and the editor saves the annotated solution along with the mark. Then, when the marker uploads the assignments to the DMS server, the annotated solution and the mark become available to the students, and additionally the mark is saved in a central repository on the server. Markers can upload marked solutions the same way as they download solutions; and specify the location of the root directory. The system will automatically upload all marked solutions and show them in a separate window for submission.

3.4 Student

The student's GUI shown in [Fig. 5] looks somewhat similar to the marker's GUI, but provides slightly different functionality. Specifically, the student can download assignment outlines, marked assignments or marks. Student also can view marks or outlines on-line; and she or he can submit an assignment solution. Note that the student is allowed to submit late assignments (it is left to the marker and the instructor to deal with this problem), but is not allowed to submit the same assignment more than once.

4 System Architecture and Implementation

DMS consists of the server and four client types. It has been implemented using CORBA, specifically OrbixWeb, see [Iona Technologies 1998]. The server maintains various persistent data, such as account information, assignment descriptions, marked assignments, and student marks. In order to allow different storage mechanisms, DMS provides clearly defined interfaces, which can be used to configure it with a file system or through JDBC with any database. Note that because of this approach all back-up and clean-up operations can be performed by this DMS and are transparent to the user. Currently, the server and each client is implemented in Java; both as an applet and as an application.

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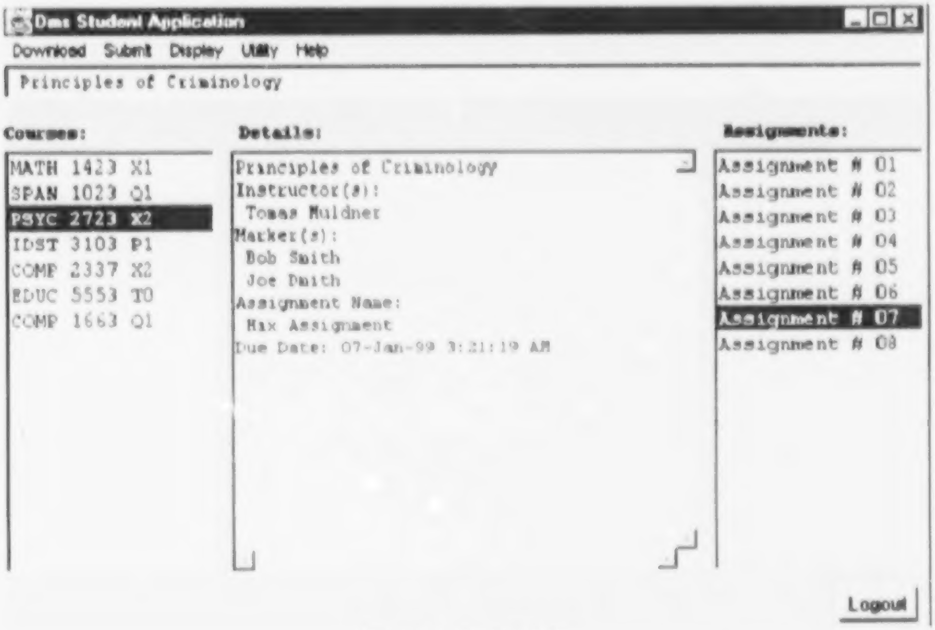

Principles of Criminology

Courses:

MATH 1423 X1
SPAN 1023 Q1
PSYC 2723 X2
IDST 3103 P1
COMP 2337 X2
EDUC 5553 T0
COMP 1663 Q1

Details:

Principles of Criminology
Instructor(s):
 Tomas Muldner
Marker(s):
 Bob Smith
 Joe Dmith
Assignment Name:
 Max Assignment
Due Date: 07-Jan-99 3:21:19 AM

Assignments:

Assignment # 01
Assignment # 02
Assignment # 03
Assignment # 04
Assignment # 05
Assignment # 06
Assignment # 07
Assignment # 08

Figure 5: Student GUI

5 Future Extensions

Currently the server generates a transient object for each client connection. These objects stay alive as long as the server is alive, but in the future version they could be used to keep track of client connections and to send notifications to users. For example, students could be notified when their assignments are marked. Additionally, these objects could also be used to manipulate the server dynamically, and allow super users to monitor the server and disconnect or limit client connections.

Acknowledgements

Most of the work described in this paper has been done as a part of the Masters thesis written by the second author of this paper. JDBC connection has been implemented by William Wightman.

References

[Dawson-Howe 1996] Dawson-Howe, Kenneth M. (1996) Automatic Submission and Administration of Programming Assignments. SIGCSE Bulletin, 28(2):40-42.
[Iona Technologies 1998] The OrbixWeb 3.1 Programmer's Guide and the OrbixWeb 3.1 Reference Guide [On-line]. Available; http://www.iona.com/products/internet/orbixweb/fordevelopers.html
[Java Applet Security 1998] Sun Microsystems. JDK 1.1.x Signed Applet [On-line]. Available: http://java.sun.com/security/signExample/
[Object Management Group 1998] Object Management Group. *The Common Object Request Broker: Architecture and Specification*. [On-line]. Available:ftp://ftp.omg.org/pub/docs/formal/98-07-01.pdf (17 September 1998).
[Pillaipakkamnatt, Wilkins 1998] Pillaipakkamnatt, Krishnan, Wilkins, Dawn. A Tool For Homework Submission Using the World Wide Web. *Webnet 98*, Orlando, 1998.
[Sun Microsystems 1998]. Sun Microsystems. *The Java Language Environment*. On-line. Available: http://www.javasoft.com/docs/white/langenv/ (11 September 1998).

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Periodic Polling for Web Cache Consistency

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Abstract: As the size of proxy cache increases, the lifetime of objects in the cache would increase. If the objects in the cache were to be stored for a long time without checking its validity, the number of stale documents would also increase. The idle network bandwidth can be used for proxy cache consistency maintenance. We propose the selection algorithm that can be used in periodic polling mechanism for the consistency maintenance of proxy cache server.

1. Introduction

As the World-Wide-Web continues its remarkable exponential growth, proxy cache size must increase to store more objects. If the size of proxy cache increases, the hit ratio of the proxy would be higher and the lifetime of the object in the cache would increase. The longer documents stay in the cache without checking their consistency, the higher is the probability that they are stale. The current HTTP protocol provides two mechanisms for cache consistency. One is a 'time-to-live(TTL)' field, which is the a priori estimate of how long a document would remain unchanged. However, in most cases, the web servers do not provide the time-to-live field. The other is a mechanism which adapts the fact that each client can send an 'If-Modified-Since(IMS)' request to the Web server. Upon receiving this request, the server checks whether the document has been modified posterior to the timestamp. If it was modified, the server returns the new object.

2. Related Work

There are several mechanisms to maintain cache consistency.: time-to-live (TTL), adaptive TTL, invalidation protocols and client-polling mechanism. TTL is an expiration-based protocol. TTL mechanism is only useful when server sends TTL fields with attached document headers to the proxy server, but this is a rare case. Adaptive TTL mechanism is also a derivative of client-polling mechanism. Adaptive TTL mechanism uses an update threshold to determine how frequently polling to the server should be performed.[Gwertzman & Seltzer 1996] Both TTL and adaptive TTL does not guarantee strong consistency. Invalidation protocol supports strong consistency, but it is too expensive because the server must keep track of the data and it should notify the copy is stale when it changes the document.[Cao & Liu 1997][Gwertzman & Seltzer 1996] Polling-every-time is another derivative of the client polling mechanism. When a client requests a document that is in proxy cache, polling-every-time mechanism sends If-Modified-Since (IMS) requests to the server. This mechanism is also expensive. Invalidation protocol and polling-every-time mechanism does not seem to be adequate for general purpose. Gwertzman and Seltzer's paper concluded that a weak-consistency approach such as adaptive TTL, would be best for Web caching.[Gwertzman & Seltzer 1996]

3. Periodic polling

By observing the log-file of the proxy server, the existence of some periods at which only the half of network bandwidth is used could be found. [Fig. 1] shows the network traffic of the KREN[1] proxy server.

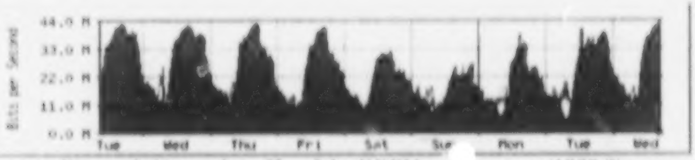

Figure 1: Network traffic of the KREN proxy server (1998.9)

At its peak time, the traffic is four times heavier than at night. We can utilize this idle network bandwidth for the consistency of proxy cache. Periodic update policy is a technique that periodically updates all documents using idle network bandwidth. Periodic polling can cooperate with adaptive TTL policy without much modification. Periodic update policy guarantees 'no more stale than the predetermined time interval' and better consistency than the adaptive TTL alone. Two decisions for periodic update policy should be made - When to update, and what to update[Kim & Chon 1998]

[Fig. 1] implies that early morning is a great time to replace stale documents for new ones. At day, idle network bandwidth does not seem to be available. If we update all documents stored in the cache every morning, this policy guarantees 'no more stale than 1 day'. We have no choice but to set the period to 24 hours for updating stale documents

3.1 Least Recently Used algorithm

Squid proxy server saves the following meta information of the documents in the cache. - validated_time, used_time and modified_time. Validated_time is the time when a proxy server confirms that the document is valid, sending an If-Modified-Since request to Web server. Used_time is the time when a client requests the document. Modified_time is the time when the document is created or modified in the Web server.

The old documents may be stale, so we would rather prefetch older documents than newer ones.[Abrams et al. 1995] LRU algorithm selects the document with the least validated_time, so we check the validness of document as following priority.

$$prefetch\_priority = \frac{1}{validated\_time}$$

3.2 Last-Modified-Factor algorithm

The consistency mechanism of the squid proxy is an adaptive TTL policy that uses the LMF algorithm. If the age of a document is greater than the max threshold time value, squid proxy considers it invalid, but if the age of a document is younger than the min threshold time value, squid proxy considers it fresh. If the age is between the min and max threshold, the squid proxy uses the LMF algorithm. Last-modified-factor is defined as:

$$LMF = \frac{current\_time - validated\_time}{validated\_time - modified\_time}$$

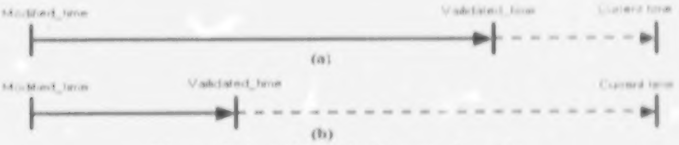

Figure 2: Last-Modified-Factor algorithm

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[1] Korean Education Network

[Fig. 2] shows how this algorithm works. If the LMF is high, a document had been modified and soon it was fetched and stored in the proxy cache and its validity has not been checked for a long time. That document's validity is more doubtable than the one of which LMF is low. In the LMF algorithm, we define the prefetch priority as :

$$prefetch\_priority = LMF$$

3.3 Weighted-Last-Modified-Factor algorithm

Squid proxy checks the validness of a document using the LMF algorithm only when a client requests it. It does not consider the probability that a document will be requested again by a client. If a document is stale and it is not to be used again, prefetching that document is of no use, and loads useless network overhead. WLMF algorithm considers that the probability that a document will be requested again and whether it is stale or valid.

LRU algorithm is used in the replacement mechanism because probably old documents won't be requested again. High validated_time of a document in the cache means that it will be requested again.

A document that has high LMF value and low validated_time may be stale but won't be used in the future. Periodic update policy doesn't need to prefetch this kind of documents. We should select candidates that is stale, but will be requested in the near future. In the WLMF algorithm, a document that has high LMF value and high validated_time also has high prefetch priority. Weighted-last-modified-factor is defined as:

$$WLMF = validated\_time \times \frac{current\_time - validated\_time}{validated\_time - modified\_time}$$

4. Simulation Environment

We use the KREN squid proxy access log and store log to simulate the content of a proxy cache. The size of KREN proxy is 12G bytes and it stores roughly 500,000 objects in the cache With the meta information of squid proxy, we can simulate which documents are to be requested and stored in the cache at a specific time.

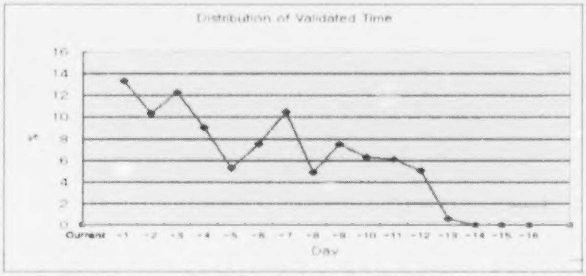

Figure 3: Distribution of validated_times in KREN proxy on 1998.9.15

[Fig. 3] shows the distribution of validated_times in KREN proxy on 1998.9.15. [Fig. 3] implies that the lifetime of a document in KREN proxy cache is only 15 days. Therefore, 15 days store log is enough to simulate the content of proxy cache. We simulate with 5 days huge store log of KREN proxy from 1998.11.1 to 1998.11.5. [Fig. 3] shows that recent 5 day store log can simulate 50% of the content of the proxy cache.

Periodic update policy selects documents and sends If-Modified-Since requests to servers at night. The more a proxy receives TCP_REFRESH_MISS reply codes, the more it selects the stale documents, because the TCP_REFRESH_MISS means that a requested document is modified. The reply code is recorded in an access log file. We selected doubtful documents from simulated proxy cache using LRU, LMF, WLMF and random selection. With the access log file of the next day, we counted the number of TCP_REFRESH_MISS events, of which URLs are same with the candidates' one.

5. Simulation Result

[Fig. 4] shows the results of the simulation. WLMF algorithm shows the best performance. WLMF algorithm was better than the LMF algorithm. This result tells us that not only the staleness, but also recentness plays an important role in periodic update policy. Two factors of WLMF algorithm are in opposition, but they cooperate so well for the maintenance of cache consistency.

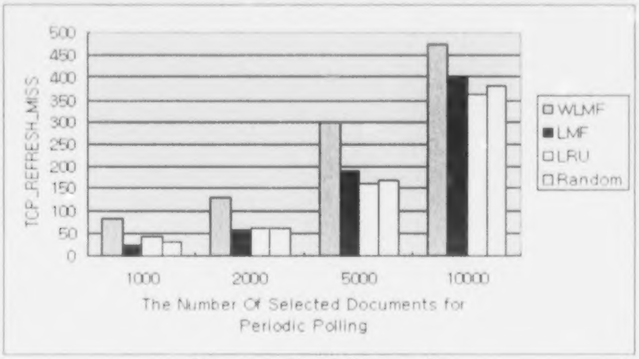

Figure 4: Simulation results

When we selected documents using the WLMF algorithm, about 5% of candidates had been modified and referenced after the day when we chose the doubtful documents. Among the documents selected by WLMF algorithm, about 13% documents were referenced on the next day. When we checked these 13% documents, about 20% of checked ones got the reply code - TCP_REFRESH_MISS and other 80% got the reply code - TCP_REFRESH_HIT.

LRU algorithm shows worse performance than random selection. The documents that we selected using LRU algorithm were in request not so much as random selection, so the total number of TCP_REFRESH_MISS is the lowest.

We simulated with only 5 days log. If we simulated using the 15 days log, LMF algorithm would select candidates that have high LMF but low validated_time. In the worst case, validated_time of selected candidates would be 15 days earlier. They would not be requested and WLMF wouldn't select those documents and the difference of performance between LMF and WLMF would be larger.

6. Conclusion

Many proxy cache consistency mechanisms were discussed in this research, But the World Wide Web is already used universally, so it is very hard to modify the structure to maintain strong cache consistency. In this paper, we propose to combine adaptive TTL policy with the periodic polling mechanism. Periodic polling mechanism brings acceptable degree of cache consistency. We can use the periodic polling mechanism without much modification of the original structure, and it does not load much overhead to network bandwidth. We showed that periodic polling using the 24 hours period is reasonable and the new mechanism to select stale documents is necessary.

7. References

[Cao & Liu 1997] Pei Cao, Chengjie Liu (1998). Maintaining Strong Cache Consistency in the World Wide Web. IEEE Transactions on Computers, 47(4), 445-457.

[Gwertzman & Seltzer 1996] James Gwertzman, Margo Seltzer (1996). World-Wide Web Cache Consistency. USENIX 1996 Annual Technical Conference, 1996, USENIX, San Diego, CA. 141-151.

[Kim & Chon 1998] Hyunchul Kim, Kilnam Chon(1998). Update Policies for Network Caches. World Conference on the WWW and Internet, 1998, Association for the Advancement of Computing in Education,

[Abrams et al. 1995] M. Abrams, C. Standrige, G. Abdulla, S. Williams, E. Fox(1995). Caching proxies: Limitations and potentials. In Proceedings of the 4th International WWW Conference, 1995, Boston, MA, 119-133.

Implementation Of School-Based Web Pages In California: Challenges for School Administrators

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Abstract: Global cooperative on-line communication manifests itself in international exchanges, electronic pen pals and other collaborative projects in California K-12 schools. Contacts by students with counties such as England, Israel, Sweden and others enriched students' experiences especially in the areas of social studies and science. This paper highlights the impact of the use of school web pages. The results of the study reveal the potential power of school web pages when appropriately managed. Two major challenges cited by administrators were concerned with the management and supervision issues revolving around student safety and the severe financial impact of the technology commitment.

Introduction

In recent times, much has been written about the use of the internet and the need for schools to be connected. This interest was underscored in the President's Educational Technology Initiative which emphasizes that American classrooms should be connected to one another and to the outside world. [President's Technology Initiative 99] The idea that all school children could be put on the internet sounds intriguing but some educators have wondered if it is just another fad. A recent study indicates that 81.8 percent of K-12 schools are connected to the Internet. The study, which was conducted by the research firm Quality Education Data [QED 98], projects that 95.9 percent of public schools will he linked to the Internet by the end of the 1998-1999 school year. According to the survey, 34.2 percent of the nation's classrooms have direct Internet access.(QED 99) While connectivity to individual classrooms is yet at a developing stage, a recent study conducted by Dr. Maria Natera-Riles, National University, found that concerns and caveats have surfaced which school administrators need to address.[Natera-Riles, 97] This paper presents implications, challenges and recommendations on the implementation of school-based web pages for K-12 schools.

According to a recent survey(1998)commissioned by AT&T Capital Corp., respondents from school districts throughout the country believe technology is a critical factor in equipping students with the skills and knowledge necessary to succeed in the 21st century. Seventy-five percent of survey respondents (school administrators, technology planners, and funding decision-makers) rank technology needs as a top priority in the years ahead. The survey also revealed that a whopping 97% of school districts have a technology plan. However, four out of ten schools indicated a lack of financial resources to implement these plans. Schools in the Upper Midwest and South demonstrated a higher than average technology funding, while schools in the East lagged behind. It is estimated that schools will require approximately $335 per student for the next three years to keep up with technology changes. The survey drew from a national sample of large, medium, and small K-12 school districts. [ATT 98]

With the introduction of the WWW the power and simplicity of the notion that a document could contain within it the name of another document and that you could go get it changed everything. [Natera-Riles 97]The most common use of internet heretofore had been the researching of materials and investigating informational sites. More and more schools are now developing web pages and publishing student work and information that can be shared throughout the world. The exchange of ideas, curriculum and collaborative research opportunities speaks to the interest of students and school personnel to encompass global information into the life of the classroom. Unlike so many previous educational "innovation" and fads promoted by educational "experts," regular teachers who have tested these waters are becoming convinced that the Web will indeed be one of those rare technologies that will have a true transformational impact on learning both in and out of school.[GSN 97]

The Web66 Registry of Educational Sites at the University of Minnesota maintains the most comprehensive list of K12 school sites on the internet. At the end of May, 1997 it listed over 8000 sites in 35 countries. The growth has been explosive since January of 1995 growing from a handful to over 8000. [Gass 97] Given the current trends to connect our nations' schools, it is expected that this phenomenon will accelerate.

Importance of the Study

The study has implications for educational leadership at the preservice and inservice levels regarding implementation strategies and effectiveness of the use of the World Wide Web in the school communities. While there may be barriers in accessing information, these barriers will begin to crumble as schools continue to join the WWW as information providers and users. This growth and expansion of web pages for individual school districts will expand the information and factual data available to students and professionals in education. This new knowledge base has resulted in new instructional units being added to university courses. The results should encourage continued investigation of implementation challenges for school administrators in order to ensure safe and academically appropriate usage of the WWW.

Purpose

The purpose of the study was to identify schools that utilize web pages, and survey administrators on their implementation strategies. The survey results identified such areas as: a. the variety of strategies used by schools to design and evaluate web-based projects b. cooperative global student activities c. administrative concerns d. academic achievement of diverse populations, e. selected demographics.

A further purpose of this investigation was to find answers to such questions as: 1. Do school administrators report concerns regarding safety issues? 2. How does an administrator help learners design and evaluate Web-based projects? 3. What risks have administrators taken and/or are willing to take to help students and teachers use this Web information to master academic tasks? 4. Do administrators encourage school-based Web pages to share tools for developing better communication with parents? 5. How do administrators help web learners to participate in cooperative on-line projects with other schools globally? 6. Do administrators see evidence that technology is changing the way teachers think and students learn? 7. Do school administrators report that the web facilitates academic achievement of students from diverse racial, ethnic, and social class groups?

Review of Literature

School-based web sites are so new for most schools, yet there are plenty of resources to identify the schools, and in some instances to help them with the development of their home pages. Several locations that identify school-based web pages were studied. These locations included Web 66, Global School Net Foundation, California Department of Education, and California County Offices of Education. In California there are 920 schools, comprised of 429 elementary schools and 491 secondary schools on the Web. The registered schools in California went from 376 to 920 in one year.[Web 66 97]

School administrators and teachers are looking at the WWW implementation strategies and its impact on students. "Examples of good practice in classrooms linked to "cyberspace" can be found: students joining astronauts as they circle the globe, piloting robotic submarines or photographing the Sahara without ever leaving the classroom. [NCES13 96] To go on even further, students can now communicate through their own publications.

Classrooms linked to cyberspace have also produced concerns of various sorts for administrators from emailed obscene writings to the horrendous expense of technology as budgetary constraints continue to plague schools. In this age of accountability, school administrators find themselves thinking twice about large expenditures in this era of raising test scores, and funding programs that may or may not succeed. Administrators face close scrutiny at every step.[Keller 96] Adding to this pressure is the issue of student safety and the use of the internet. Educational leaders must find creative and practical ways to address concerns with student emotional, physical and academic safety at school and in cyberspace.

The increasing number of schools with home pages, has encouraged the collaboration, communication, and exchanging of information. Educators and students can and do design successful collaborative projects involving hundreds of classrooms and thousands of students. Creative usage of the WWW is a pervasive and consequential instructional force to be mastered and studied critically in this global transformation process.

Students can explore the cultural diversity of their own community and extend it to include the global community. When teachers and their students are connected to the world, there begins to be an understanding, appreciation and respect for cultural, political, environmental, geographic and linguistic similarities and differences. [NCES13 96] On-line chatting sessions can be made available for bilingual/translated exchanges. As students learn more about themselves and others they are more prolific and exact in their writings and more interested in researching and exchanging ideas.[Andres 98]

Transformation change appears to be occurring as teachers and students become involved in the creation of cyber communities. Teachers report that this is not just one more fad.

Research Methodology

The research methods consisted of surveying selected administrators and/or webmasters of K-12 schools with web pages. The procedure involved researching registry sites such as Web 66, Global House and county offices of education. Followed by a random selection of 120 sites. The next step was to identify the administrator or designee email addresses for the survey. The National University MIS Department(Management Information Service) provided assistance at the server level by programming CGI(Common Gateway Interface) capabilities for data gathering and tabulation. The lead researcher, received a small university presidential award to conduct this study.

The study was limited to California K-12 schools. The schools selected were comprised of elementary, middle schools, and high schools. Fourteen surveys were completed and returned. While the district response expanded the number of schools surveyed to more schools, site administrators from the districts did not participate. This study replicates an investigation expanding the geographical area in California and the number of school.[Natera-Riles 97]

Results of the Study

The most important findings of this research regarding the implementation of school-based web pages is the enthusiasm of principals and other webmasters for cooperative on-line projects with other schools, administrators see evidence that technology is changing the way teachers think and students learn, and that 13 of 14 schools responding reported a believe that on-line experiences facilitate academic achievement of students from racial, ethnic, and social class groups. Schools identified sharing papers and historical research topics with a school in England and may be doing one with a school in Thailand; electronic pen pals; e-mail collaborations with schools in other countries such as Israel and Sweden; maintenance of listservs and ensure that network connectivity is provided Wild Ones through Columbia University; weather observations and cultural exchanges. All but one respondent indicated an interest in using the web for cooperative and on-going research.

Implications, Challenges and Recommendations

The purpose of the study was to identify schools that utilized web pages, and survey administrators on their implementation strategies. The survey results identified such areas as: a. the variety of strategies used by schools to design and evaluate web-based projects, b. cooperative global student activities, c. administrative concerns, d. academic achievement of diverse populations, e. selected demographics.

The administrators were surveyed by e-mail. The survey responses, however limited, produced some information and concerns about the implementation of school-based web pages. As districts and individual schools become more proficient in the use of school web pages, the resulting web page design and information included become more sophiscated. Of significant note is the finding that although increasing numbers of schools are utilizing web pages, no evaluation of the implementation strategies was reported. However, a variety of activities including administrative leadership and support such as familiarizing teachers with: the web, content, eye catching subject areas, templates, latest research, and professional help with web design as they start to feel comfortable. Administrative support at the site level is more evident at the elementary level. Elementary principals appear to be more actively involved in the implementation of technology and on-line curricular activities, but evaluative strategies are lacking.

Of the individual schools responding to the survey only one did not report participation in cooperative on-line projects with other schools and agencies. Examples of cooperative on-line participation included: international exchanges, electronic pen pals, weather observations, historical research topics with England and Thailand, collaborative projects with countries such as Israel and Sweden in the areas of social studies and science, maintenance of listservs, NASA, and projects with universities such as the "Wild Ones". Schools are finding that the curriculum can be enhanced by the use of the web in cooperative projects. There is evidence that through cooperative global exchanges the students are becoming more aware of geography and the scientific process of research.

Concerns involving administrative risks for student safety and tech budgets were also significant. Schools shared some ideas on the handling of administrative risks that included the following: not publishing pictures of students, warning teachers about some of the unsavory or misinformation on the web, developing a "fail-safe" grouped, annotated list of resource sites that the administrators have personally visited. Other risks reported included the severe expense of the technological commitment.

However, it is important to note a large majority of the schools reported a belief that on-line experiences facilitate academic achievement of students from diverse racial, ethnic, and social class groups. This view is underscored by the reported numbers of schools that have fully translated web pages in Spanish. Reported implications indicate that: fair technology deployment has the potential for leveling equity.

Demographics reported of significance included: Thirteen of the respondents were males and there was one female. The respondents included 6 Principals, 5 teachers, and 3 web masters. It appears that more males are involved in the leadership role in the utilization of web pages. It is recommended that: 1. Follow-up studies be conducted to include a larger sample of schools throughout the nation. 2. Increase federal, state and local funding be appropriated for encouraged participation in the following areas: a. cooperative on-line projects, promote interchange with diverse population within the country and globally. 3. Continue to improve communications with local parents and communities with translations of the school-based web page to significant language or languages at the local community. 4. Provide guidelines for those that are implementing web page strategies to insure student safety. 5. Develop evaluation procedures for web page strategies. 6. Female faculty be encouraged to participate in technology. 7. School administrators at all levels be pre-serviced and inserviced to become proficient in the development of school-based web pages and to provide faculty support for web site usage.

References

1. AASA7. Technology Today. Available World Wide Web: http://www.aasa.org/tech.htm
2. AT&T Capital Corp. Available World Wide Web: http://www.attcapital.com
3. Andres, Yvonne Marie. Collaboration in the Classroom and Over the Internet. Available World Wide Web: http://www.gsn.org/teach/articles/collaboration.html
4. Fanning, James. Expanding the Definition of Technological Literacy in School. Available WWW: http://www.mcrel.org/products/noteworthy/jimf.html[1996, July 15]
5. Gass, James. Making the Most of the World Wide Web for Your Organization. Available World Wide Web: http://www.gsfc.nasa.gov/documents/making_most_www.html

6. Global School Net Articles9. Available World Wide Web: http://www.gsn.org/gsn/articles/index.html[1996, Oct 20]
7. Growth of the Web in Schools and Beyond. Available World Wide Web: http://www.gsn.org/web/intro/w3phenom.htm#begin
8. Hillside Elementary School10. Available WWW: http://hillside.coled.umn.edu/
9. Keller, Bess. "In Age of Accountability, Principals Feel the Heat", Education Week. Volume XVII, #36, May 20, 1998.
10. Natera-Riles, Maria. Utilization of School-Based Web Pages: A Study in Progress Addresses Challenges for Administrators. Available World Wide Web: http://newlinks.tc.columbia.edu/
11. NCES13. Available World Wide Web: http://www.ed.gov/NCES/pubs/96854.html[1996 Oct 15]
12. Promises, Promises. Available World Wide Web: http://www.pbs.org/merrow/pp.html
13. Public Service Telecommunications Inc. Available World Wide Web: www.ciconline.com
14. Quality Education Data (QED). Available World Wide Web: http://www.qedata.com
15. Rogers, Al. Global Literacy in a Gutenburg Culture. Available World Wide Web: http://www.gsn.org/teach/articles/gutenburg.html
16. The President's Educational Technology Initiative. Available World Wide Web: http://www.whitehouse.gov/WH/EOP/edtech/html/edtech_f.html
17. US Department of Education14. Getting America's Students Ready for the 21st Century, Meeting the Technology Literacy Challenge. Available World Wide Web: http://www.aasa.org/tech7.htm[June5]
18. Web 66 : A k12 World Wide Project, California Page. Available World Wide Web: http://66.coled.umn.edu/schools/US/California.html

A Guide to Moving Language-Learning Curriculum onto the Internet

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Abstract: Moving traditional, paper-based language curriculum to the World Wide Web requires more than a simple transfer from the physical to the electronic. This paper explores the steps to consider taking before creating web-based language learning activities, using the task of teaching new English vocabulary to Japanese students as an example. It begins with an examination of the pedagogical shape of the sample task, identifying the components that make it up. Next, the paper examines the symbolic fit of the task into the functional shape of the Internet. Then, it explains how to sculpt the activity, adding functionality drawn from the capabilities of the WWW. Finally, the paper describes a web-based vocabulary activity that has been built based on the steps explored.

1. Introduction: Square pegs in round holes

Teachers used to shy away from bringing new technology into the classroom. From 'the school of the air' radio programs in the 40's and 50's to educational television, new technologies have not been welcomed whole-heartedly by educators. [Oppenheimer, 1997] Now, along comes the Internet, or more specifically, the World Wide Web, and attitudes seem be changing. Teachers are embracing the Web as an educational tool. [Oppenheimer, 1997; Fidelman, 1998] The last few years have seen an explosion of interest in using web-based curriculum to enhance education. However, as with those earlier technologies, the move to the web has been somewhat disappointing. Aside from the technical problems (slow connection speed, buggy applications, crashing machines), web-based education experiments have leaned toward the cute, the colorful, and the pedagogically weak.

The problem may lay in the direction from which use of the Internet is approached. I recently spent an enjoyable evening watching my 18-month-old nephew play with wooden blocks of various shapes. The idea was to put the blocks into holes of matching shape, the star-shaped block into the star-shaped hole, the square with the square. But he didn't care much for the rules of the game, preferring to try and jam any given block into any hole on the board. The insertion of curriculum into the WWW has taken a similar tack. Many teachers, myself included, have been trying to force traditional courseware onto the Internet, regardless of how well it fits. It is time to stop for a minute, step back, and examine the shape of both our own curriculum and the WWW. How does the shape of what we want to do fit?

In this paper, I will start with a basic task, teaching new English vocabulary to Japanese students. I will examine the pedagogical shape of the task, and see how it fits into the WWW "hole." Next, I will look at the shape of the Web, examining what capabilities the WWW has that might be used to add to the effectiveness of the vocabulary activity. Finally, I will describe a web-based activity that has been built based on the steps explored in the paper.

2. Defining the shape of the learning task

There are two ways to learn new vocabulary: implicitly or explicitly. With implicit learning, students pick up new words as a by-product of doing something else, like reading or watching TV. In explicit learning, students' attention is drawn to new vocabulary, and they asked to memorize it [Hatch and Brown, 1995; Nation, 1990]. This is the kind of learning that forms the basic shape of the learning task to be dealt with here. To bring the shape into finer focus requires an examination of how to go about presenting new vocabulary to second language students, and how best to help them remember it.

Fortunately, there aren't too many options when it comes to presenting new words. By far the most common is the basic list of words and their definitions [Lehr, 1984; cited in Hatch and Brown, 1995]. There is some question as to whether such word glosses should be mono- or bilingual. Nation [1990] reports that first-language translations of definitions hold several benefits, including quickness, relative ease in defining all types of words, the ability of students to respond quickly to demonstrate their understanding of a word. Also, it has been shown that students using bilingual lists score higher on vocabulary tests than students using monolingual lists [Oskarsson, 1975; cited in Hatch and Brown, 1995].

How best to remember a new word is less straightforward. Nation [1990] reports that decontextualized, rote memorization can be an effective way to quickly learn new words. However, this style of vocabulary learning may not lead to long-term retention, or promote productive word use. Presenting words in some context may help, once students have reached a certain level of second language competency [Nation, 1990; Nagy, 1997].

Oxford [1990] suggests that activating as many senses as possible can strengthen word-definition memory connections. For example, students can view pictures representing the new word (visual), hear the word pronounced or hear it used in a sentence (aural), or hold the object in their hands while learning the word for it (tactile).

Repetition may also play a part in new word memorization. Studies have found that by presenting a new word repeatedly over time, students can better retain new words [Kachroo, 1962; cited in Nation, 1990; Stevik, 1996].

So let's examine the language task at hand: learning new vocabulary. The words can be presented as a list of words and definitions. The definitions can be either in English or in Japanese, or both. Showing how the words are used in context might be useful, as would allow the students to hear the new words pronounced. Finally, presenting the words repeatedly over time seems to be a good idea.

3. Examining the fit

Now that we have a fairly well defined shape to work with, let us see how that shape fits into the WWW. Certainly, web pages can be used to present lists of words and definitions. Also, most recent web browsers can show text in both English and Japanese. Similarly, web pages can just as easily display words used in sentences to give the students contextual examples. And words can be presented repeatedly on the web, through various pages and activities for the duration of a class. Recording the words for playback on the web is a simple task, so students could easily listen to the words being pronounced.

At first glance, it seems a perfect fit. Every piece of the pedagogical puzzle fits. So why is there an underlying feeling of unease, a nagging sense of "so what?" It might be because, while the web can do all of these things, so can pencil, paper, and a tape recorder. So why use the Web at all? It would be like using a jumbo jet to go to the local supermarket. It is time to look a little more closely at our task.

4. Sculpting the task

If my young nephew had access to a good wood chisel and the manual dexterity for the job, he could shape the star block to fit into the square hole. So it is when teachers move traditional activities onto the Internet. They often rework a perfectly good classroom activity in unnatural ways to make it fit in cyberspace. But in the case of our task, teaching new vocabulary, the activity already fits. The problem is that it doesn't completely fill the Internet space. It doesn't make much use of the functionality built in to the Web. Instead, our task resembles a circular peg, sliding easily into the large, star-shaped hole of the Internet functional space. [Fig. 1]

Our Task
Internet Space

Figure 1: Functional Activity and Internet Space

Let us examine the points of that star to see what capabilities the Internet has that could be added to our task. In doing this, however, we must walk a fine line between adding features that improve the task, and adding flashy fluff just because it is possible to do so.

4.1 Instant feedback

One capability available to WWW-based activities is instant feedback. When students complete paper-based vocabulary activities, they must turn in the activities, wait for them to be corrected, and then (hopefully) review the words they missed. This process can take a long time, and the delayed feedback is of dubious effectiveness. Contrast that with the same activities on the Web. Using web-centric programming languages, such as Java or JavaScript, web activities can be created with a level of interactivity comparable to stand-alone computer-based activities. One thing computer-based activities have to their advantage is the ability to provide interactive, individualized instruction and feedback [Kang and Dennis, 1995; Ariew and Frommer, 1987; Cobb and Stevens, 1996]. With computer-based activities, students can receive feedback continuously, as they work through them. The feedback can take many forms, from simple "right" and "wrong" messages, to suggestions and guidance to help understand why a given answer is incorrect, and how the correct answer can be found [Kulhavy and Wager, 1993; Robinson, 1991].

4.2 Data-tracking

Think for a moment about how you might go about memorizing new words in a second language. Maybe you have a stack of flashcards with words on one side and first-language translations on the other. You move quickly through the stack, putting the mastered cards in one pile, and the troublesome ones in another. As time goes by, you continue to study new words, mixing in the missed words from earlier study sessions. Once a given word has been internalized, you put that card away, focusing only on the new and difficult words. Using CGI (Common Gateway Interface) scripts, Web-based vocabulary activities can do this and more.

CGI is the standard method used to communicate between web-based programs and forms and server-based programs or databases [Zhang, T. and Till, D.; 1997]. Using web forms or Java applets that communicate with CGI scripts residing on the server, web-based vocabulary activities can track a wide variety of data about each student's work. As a student works through an activity, it can store his or her answers to each question. When the student reaches the end of an activity, he or she can be presented with a list of missed words. These words can then be instantly reviewed. As the student continues through a course, previously missed vocabulary words will pop up in the activities from time to time, until the student has mastered them.

In addition to tracking individual data, web activities can be designed to watch trends in a group of students. Say that a group of students is asked to memorize 20 new words. By having them use web-based activities to study the new words, teachers can track which words are most difficult overall. This can be done by having the activities send a list of the most frequently missed words to a file on the server. These words can then be reviewed in class. Through the same method, teachers can discover which words are rarely missed by any student. These words could become candidates for elimination from the pool of vocabulary to be studied by future classes.

Another kind of data that can be tracked is time. Web activities can register the amount of time that a student spends on each question, or on the activity as a whole. This kind of data can be very useful for the teacher. For example, if a student correctly matches a word with its definition in less than a few seconds, it may be assumed that that word has been mastered (or at least the receptive recognition of the word). In fact, an activity could be designed that would require a student to match words and definitions in less than a specified number of seconds. If it takes a student more than that time to answer a question, it is stored and presented again later, until the student can recognize it instantly.

4.3 Help systems

With traditional vocabulary activities, students can get help in a couple of ways: they can ask their teacher, or they can ask their friends. A well-designed web activity can dramatically improve on these methods. Envision the same simple activity in which students match words to their definitions. A student is presented with a word, but cannot remember its meaning. The web activity can offer a wide assortment of assistance. For example, students might be able to click on a word, calling up a help window that shows the word used in a sentence. They could click a button and hear a digital recording of the word. Perhaps the definition of the word can be given in Japanese. A streaming video of the teacher explaining the meaning of the word can be offered.

As previously discussed, all of these things can be done using more traditional methods. The advantage of the web medium is that the help can be offered at the right time, in the form most beneficial to a given student. Instead of getting a list of explanations, translations, or a cassette tape to search through, the student is shown help only for the word being studied at that moment. This idea dovetails nicely into Vygotsky's notion of language education, called "the zone of proximal development." As described by Oxford and Scarcella [1992], this idea states that students can master material high above their current language level, if they receive individualized help of just the right type, at just the right moment. Carefully designed web activities can do just this.

5. Designing the web activities

We are finally ready to begin creating the web activity. We have a good idea of the kind of pedagogy that should guide development, along with a sense of the capabilities web activities have that are not available with traditional paper-based activities. In effect, we have a recipe to work from to create a web activity that will help students learn new vocabulary. This section will examine an actual activity, based on the "recipe" described above, and currently being used by Japanese students at the University of Aizu. At the same time, the missing ingredients, possible future improvements, will be discussed.

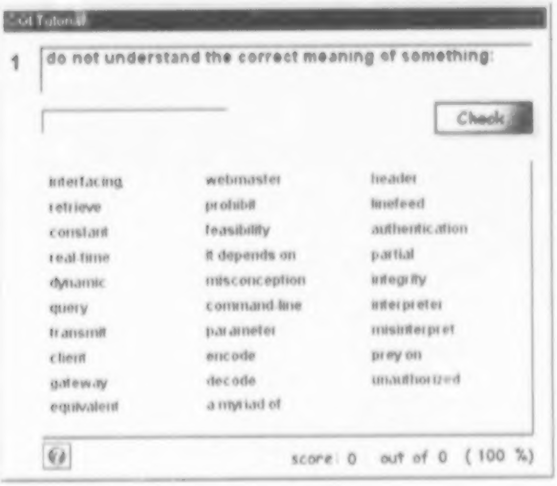
5.1 Web-authoring software

The activity described here was created using Macromedia Director, a software authoring system that allows one to create interactive web applications. Director applications saved in the "Shockwave" format can be run on most web browsers. Both Windows 98 and Macintosh OS 8.5 come with the Shockwave plug-in pre-installed.

All the pedagogical components discussed thus far can be realized without such an authoring system, through a combination of HTML documents and CGI scripting. Director is useful in that allows for seamless integration of text, sound, and images into a self-contained activity. In addition, with Director, the data being tracked can more transparently be passed between the web activity and a server database.

5.2 Words and definitions

The most basic ingredient is a list of words and their definitions. To help students memorize the list, our activity presents them with a definition, and then asks them to match it with a word from a list of new vocabulary. [Fig. 2] Another possible method would be to present a word, and have the student select the matching definition from among four choices. There is one major advantage to doing it the first way. Selecting a word to match a given definition eliminates the need to come up with effective distracter definitions.



1 do not understand the correct meaning of something:

interfacing
retrieve
constant
real-time
dynamic
query
transmit
client
gateway
equivalent

webmaster
prohibit
feasibility
it depends on
misconception
command-line
parameter
encode
decode
a myriad of

header
linefeed
authentication
partial
integrity
interpreter
misinterpret
prey on
unauthorized

score: 0 out of 0 (100 %)

Figure 2: Vocabulary Activity

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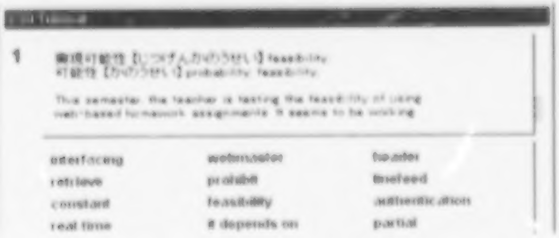
5.3 Help system

The activity includes a help system, combining several of the aforementioned ingredients. While in the help section, students can click on any word in the list, and view its Japanese equivalent, see it used in an English sentence, and hear it pronounced. [Fig. 3]



1

This semester, the teacher is testing the feasibility of using web-based homework assignments. It seems to be working.

interfacing
retrieve
constant
real time
[illegible]
prohibit
feasibility
it depends on
[illegible]
[illegible]
authentication
partial

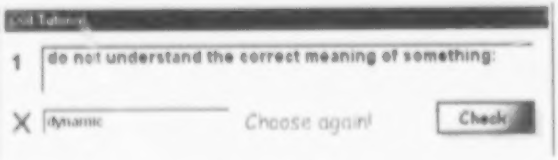
Figure 3: Help system

The help system in web-based activities should supplement, rather than replace other forms of help. With this in mind, pages with activities include an e-mail link to the teacher, allowing students to ask for individual help.

Future activities could link into an online corpus, allowing a student to see a word used in any number of sentences. For words referring to physical, concrete objects, a picture or line drawing of the object could be shown.

5.4 Feedback

The feedback messages have been kept simple. When students attempt to match a word to a definition, they are told immediately whether it is correct or incorrect [Fig. 4]. By keeping feedback messages simple, students are able to move quickly through the list of definitions, working toward the goal of quick recognition. If students want a more detailed response, they can find it in the help section.



1 do not understand the correct meaning of something:

✗ dynamic Choose again!

Figure 4: Feedback

5.5 Data-tracking

The activities track several pieces of data about each student. First, incorrect choices are recorded, and recycled for review. Incorrect choice tracking takes two forms: short- and long-term. In short-term tracking, the missed questions are repeated within an exercise, until the student is able to correctly identify them. In long-term tracking, the missed words and definitions are stored in a server database. In proceeding unit activities, previously missed words are occasionally inserted until a student is able to match them quickly and consistently with their definitions.

At the University of Aizu, the activities are given as graded homework. Consequently, student scores are automatically sent to a server-based database for later importation into a grading program. In addition, each student receives an e-mail message upon completion of an activity, confirming that his or her score has been successfully recorded.

Future activities could record the time taken to answer each question, along with information about help system usage. A list of those words for which students most often seek help could then kept, as well as a list of which words took the longest to recognize. This information could be used to guide in-class review sessions.

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5.6 Randomization

The order in which the definitions are presented is randomized for each student, and changed each time the student tries the activity. This helps avoid "pattern memorization", in which students simply remember the order of the answers. As a side issue, randomization also helps prevent sharing of answers among students doing the activities outside of class.

6. Conclusion

Moving from traditional, paper-based language practice to web-based work requires more than a simple transfer from the physical to the electronic. Teachers need first to examine the specific task they want to move online, listing the components that make up that task as it is usually performed. Next, teachers should investigate how well those components can be transferred to the WWW. Finally, the task itself can be sculpted to make it more effective, pedagogically, using capabilities built in to the WWW.

By following through these steps before the actual creation of web-based activities begins, it is possible to develop activities that have a solid foundation of theory, coupled with dynamic functionality difficult to achieve through more traditional methodology. Put simply, define the shape of the task first, and compare that shape to the functional "hole" of the WWW. Then add functionality where appropriate to create a better fit, and a better learning tool.

7. References:

Alessi, S. & Trollip, S. (1991). *Computer-based Instruction: methods and development*. Englewood Cliffs, NJ: Prentice Hall.

Ariew, R & Frommer, G. (1987). 'Interaction in the computer age', in W. Rivers (ed.) *Interactive Language Teaching* (177-193). Cambridge: Cambridge University Press.

Cobb, T & Stevens, V. (1996). 'A principled consideration of computers and reading in a second language', in M. Pennington (ed.) *The Power of Call* (115-135). Houston, TX: Athelstan.

Fidelman, C. (1998). 'Growth of Internet use by language professionals', *Calico Journal* 15(4): 39-57.

Hatch, E. & Brown, C. (1995). *Vocabulary, Semantics, and Language Education*. Cambridge: University Press.

Kachroo, J. (1962). 'Report on an investigation into the teaching of vocabulary in the first year of English', *Bulletin of the Central Institute of English* 2, 67-72.

Kang, S. & Dennis, J.R. (1995). 'The effects of computer-enhanced vocabulary lessons on Achievement of ESL Grade School Children', *Computers in Schools* 11(3): 25-35.

Kulhavy, R. & Wager, W. (1993). 'Feedback in programmed instruction: historical context and implications for practice', in Dempsey, J. & Sales, G. (ed.) *Interactive Instruction and Feedback*. Englewood Cliffs, NJ: Educational Technology Publications.

Lehr, F. (1984). 'Promoting vocabulary development', *Journal of Reading* 27, 656-658.

Nagy, W. (1997). 'On the role of context in first- and second-language vocabulary learning', in Schmitt, N. and McCarthy, M., *Vocabulary: Description, Acquisition, and Pedagogy*. (64-83). Cambridge: Cambridge University Press.

Nation, I.S.P. (1990). *Teaching and Learning Vocabulary*. Boston, MA: Heinle & Heinle.

Oppenheimer, T. (1997, July). 'The computer delusion', *The Atlantic Monthly*, 45-64.

Oskarsson, M. (1975). 'On the role of the mother tongue in learning foreign language vocabulary: an empirical investigation', *ITL Review of Applied Linguistics*, 27, 19-32.

Oxford, R. (1990). *Language Learning Strategies: what every teacher should know*. New York, NY: Newbury House.

Robinson, G. (1991). 'Effective feedback strategies in CALL', in P. Dunkel (ed.) *Computer-assisted Language Learning and Testing: Research Issues and Practice*. (155-167). New York, NY: Newbury House.

Scarcella, R. & Oxford, R. (1992). *The Tapestry of Language Learning: The Individual in the Communicative Classroom*. Boston, MA: Heinle & Heinle.

Stevik, E. (1996). *Memory, Meaning & Method: A View of Language Teaching*. Boston, MA: Heinle & Heinle.

Zhang, T. & Till, D. (1997) *Perl 5 for Windows NT in 21 Days*. Indianapolis, ID: Sams Publishing.

PIE - Problem Based Learning, Interactive Multimedia and Experiential Learning

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Abstract: This paper discusses design of web-based interactive multimedia for collaborative learning. Experiential learning combined with interactive multimedia has received a great deal of attention in both educational practice and research. Advancement of multimedia technology also provide an opportunity to extend problem based learning and combine it with experiential learning. A prototype application was designed and evaluated in two different settings: university and industry. The conclusion is that the prototype works as a tool to integrate experiential learning and problem based learning.

1. Introduction and Background

A great deal of attention has been focused on interactive multimedia, especially within the educational domain. Many educational institutions have produced different types of educational interactive multimedia courseware to replace or enhance educational activities. In this paper we discuss how interactive multimedia can be used to combine experiential learning (EL) and problem based learning (PBL).

EL and PBL are alternative pedagogical models that are gaining popularity in all levels of the education system. Computing education such as software engineering, management information systems, computer information systems and informatics are no exceptions. The context for this research is computing education and training in a broader sense. In this paper we use *project failure* as an example of a phenomenon that occurs frequently in different types of projects to exemplify our ideas.

IT project failures are well known to researchers and practitioners in both industry and academia. See for instance [Nulden and Scheepers 1998] for a discussion. Project failure is of course strongly related to project management, a practical task educators often find difficult to teach realistically with traditional and conventional methods. Courses covering project management often simulate real world project like situations. The early project management simulations were built on very rational ideals, while current simulations include more complex dimensions. Today, educators design cases and simulations where students are requested to perform in realistic situations and under business pressure. Common ways to enhance the realism is communication and interaction with simulated project staff, users and consultants. Another way is pin pointing typical project problems such as absenteeism, staff diverted to higher priorities, design problems, technical problems, changed requirements, personality conflicts, overstaffing and resignations. Educators try to make sure the students experience the situations as real as possible.

With problem based learning, interactive multimedia, experiential learning and computing education, more specifically project management and project failure, as a theoretical and contextual background we formulate the following three research questions to be further elaborated in this paper: First, how can interactive multimedia enhance problem based learning? Second, how can experiential learning and problem based learning be integrated in a methodology? And third, can interactive multimedia vignettes be used outside a formal education system to train and educate in project management related issues in corporate training programs?

2. Learning and Facilitating Learning

In this section I briefly discuss problem based learning and experiential learning. It is assumed that the reader have some bascic knowledge about these two pedagogical approaches. PBL is a way of designing and conducting educational activities using problems as stimulus and focus for learner activity. In experiential learning the educator is providing some form of stimulus to help students have an concrete experience.

2.1 Problem Based Learning

Problem based learning is: "... a way of constructing and teaching courses using problems as the stimulus and focus for student activity. It is not simply the addition of problem-solving activities to otherwise discipline centered curricula, but a way of conceiving of the curriculum which is centered around key problems in professional practice" [Boud and Feletti 1991 p.14]. Hence, the starting point of learning in PBL is a real world phenomenon or problem the learner wishes to learn more about. That is, a problem that is relevant from the perspective of the learner's future profession. The problem, or rather the problematic situation, is identified, designed and presented to the students, who then themselves define what the actual problem is.

The responsibility of the teacher is to present or introduce the phenomenon or problem in a stimulating way. In PBL terminology, this starting point is called a 'vignette' and is mainly understood as a starting point for self-directed learning. In many ways, PBL is an implementation of the constructivistic model of learning. This means that people can only understand what they have constructed themselves [Leidner and Jarvenpaa 1995]. Since the group is an important resource for the learning process in PBL we have a cooperative model of learning or collaborativism [Slavin 1990].

The practical implementation of PBL does of course vary. This paper discuss only one possible model. See for instance [Boud and Feletti 1991] for a more lengthy discussion about PBL in practice. The experience of actually working with the vignette is less emphasized in discussions about PBL in practice. Therefore this research look into the notion of experiential learning.

2.2 Experiential Learning

Experiential learning refers to small group work, were what is learned is directly related to what happens in the group and how it happens. Various terms have been used to label the process of learning from experience. Dewey used learning by doing, and others have discussed this process in terms of *learning-in-doing* [Kolb 1976].

Experiential learning is participative, interactive, and applied. It involves the whole person; learning takes place on the cognitive, affective and behavioral dimension [Gentry 1990]. Already 1916, Dewey noted that schools continued to tell students what to learn despite research clearly showing that teaching by telling does not work, and that learning by doing does work. It is claimed "learning is best facilitated in an environment where there is dialectic tension and conflict between immediate, concrete experience and analytical attachment" [Kolb 1984].

Experiential learning in various forms has been practiced since the early 1950's. Examples of experiential learning are internships, live case, case studies, role-play, games and simulations. Different types of simulations are probably the most common and has long been a feasible way for educators to present complex matters such as visualization of mathematical, production and logistic processes.

3. Interactive Multimedia

Innovations in technology, such as multimedia, hypertext, video, the Internet and virtual reality, are now having an impact on teaching and learning. The design of interactive multimedia (IMM) has undergone a revolution in the last ten years. Trivial HyperCard stacks and behaviorally oriented drill and practice applications common in the 80's have given way to richer interactive applications where the learner is relatively free to explore at her own pace. However, much of the multimedia training is no better than the old — it just looks sexier. We can also see a shift from CD-rom towards the 'web', as a dominating technology, but also a shift from multimedia for individual learners towards multimedia application for teams or groups of learners.

The use of hypertext and hypermedia permits links among pieces of information such as text, sound and graphics, that permit the user to "explore ideas and pursue thought in a free and 'non-linear' fashion" [Bieber and Kimbrough 1992]. Kendall et. al. compare a hypertext based (IMM) systems analysis case with a conventional case and role playing [Kendall, Kendall et al. 1996]. They found that use of hypertext allows students to navigate through the organization, interviewing and examining documents in the order they prefer rather than in the pre-described linear fashion. Their conclusion is that hypertext was an important departure from the traditional activities conducted. The interactivity and non-linearity of hypertext means that the students learn systems analysis and design by exploring an organization, rather than reading a case study of one.

In a systems development education context, Farrimond et. al. are applying current multimedia techniques to transform current paper based case studies into interactive multimedia simulations [Farrimond 1997]. They have developed a mouse driven virtual world. The goal of the interactive case study is not to lead or guide the students towards a specific goal but to provide a context in which to explore the 'real' world. The world in the simulation is a set of interconnected rooms that are populated by people, documents and other objects. The students construct own meaning by interacting with the material rather than being taught something explicitly.

These are just two examples, but they and other simulations we have studied are quite similar to what we suggest in this paper. However, none of the simulations is explicitly building on the model of problem based learning. In the following section these ideas further are further elaborated.

4. Design

We surveyed twenty one master level students, ten men and eleven women, average age of 28 and all with at least six months experience of PBL, about their experience with PBL. The survey was analyzed by coding of keywords in their responses. The keywords were then categorized in the following three groups. First, working with PBL quickly became routine and the groups developed a standard behavior to work with the problem. Second, the vignettes were perceived as lacking relevance and not dealing with timely issues. And third, the lack of variation of the format of the vignettes.

Our major conclusion from the survey is that a great number of vignettes seem to have very low quality when it comes to stimulating and challenging the students. Supported by the literature, the result of the survey, and our own experience as facilitators we started to elaborate our ideas about multimedia vignettes. [Fig. 1] below summarizes the conceptual ideas of integrating problem based learning and experiential learning.

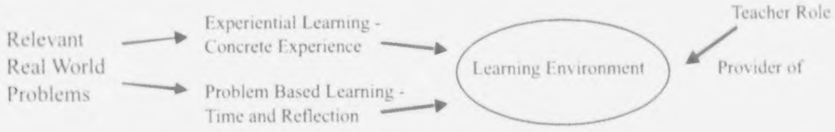

Figure 1: Design Framework

From here we started the design of a vignette about IT project management and failure as discussed in the introduction. The objective with this vignette was to direct the attention of the students to the complexity of IT project management. The students should act as project members and navigate through a project over time and make decisions about the project. [Fig. 2] below is an outline of a whole vignette.

The students get some background information to make decisions. The intention is to make the students, not only read about the problem, but actively be part in the creation of it. They experience the sense of time and how they have been part of the project during this time. Decisions are actually made by the students and they have thereby invested themselves in the decisions.

In the vignette, time passes in the project and the group faces additional information, and has to make other decisions. Finally, as [Fig. 2] about the whole case shows, the group will end up in the single last scene of the vignette. This is how the educator responsible for the vignette makes sure the students meet the learning objectives of the PBL session. Let us give an example of a possible end scene. After the group has worked with the vignette for one hour and been confronted with various project problems, they have been making a number of decisions about database managers, upgrading of software, hiring and firing of people etc. They are becoming more and more aware that the project is probably about to fail. The last scene is from the board-room were the president of the company and the CIO question your (the group's) ability to manage the project.

To generalize the ideas, an important aspect of this research is to develop and establish a terminology for designing cases as described in this paper. The *scene* serves as building blocks for the vignette. New information about the scenario is presented in each scene and the group is required to make decisions about matters such as technology, personnel and dates. Each scene in the vignette consists of a series of web-pages with one or a number of objects embedded. Examples are graphics, sounds, movies or database interfaces. The purpose of a scene is to present information to the base-group and in some of the scenes the group is then required to make a decision.

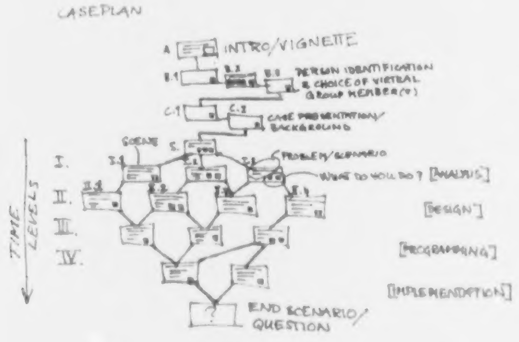

Figure 2: Outline of the whole vignette

To evaluate the ideas, as described above, a simple prototype of a sequence of scenes was implemented in Microsoft Power Point (PP). The scenario contained a number of scenes setting the stage and providing the group with the background information about the problematic situation. This information was presented in smaller blocks of text on several PP slides. The purpose of this was, as discussed above, to allow the group to reflect and discuss issues raised in the scenario while it was presented. After the group had received this information, scenes, where the students were required to make decisions before continuing, were presented.

5. Evaluation

In the evaluation phase we decided to include people from the industry. Therefore, two groups, one at the Business School of a Swedish university, and one at a large manufacturing industry in Sweden, were selected to participate in the evaluation. We decided to evaluate the vignette with the student group first as approaching the students first would minimize the possible errors we otherwise would bother the professionals with.

5.1 Observing the Student Group

The student group participating in the evaluation consisted of a subset of the group surveyed about their opinions about PBL. The setting for the evaluation was a conference room with a table, a portable computer, a projector and a large screen to project on. The students were given a short description of our analysis of the survey, our ideas in general and the purpose of the vignette they were about to work with.

The group worked quietly with the first eight scenes containing the background information. They nodded their heads when they were ready and waited for the next scene. No discussion or comments were made. However, when the first interactive scene appeared the discussion started. The discussion followed a pattern we had expected, but they also raised issues concerning the actual ideas about the prototype. The group constantly made connections to their own experience of PBL. Short comments were made during the information scenes and more extensive discussions took place in the interactive or decision scenes. The group worked and discussed in an efficient and goal oriented way. It was obvious that their experience of PBL helped them in structuring the group work in this phase of the PBL model.

All members of the group found the prototype and the scenario to be of value. According to them it was easy to understand, although some found it to be too much text in some of the scenes. None of the students found the design to be too simple. A richer multimedia form with more embedded objects would not automatically raise the quality of the vignette, probably the opposite. However, the interaction was found limited due to the interactive case implementation with sequential scenes. Observing the students, it was very interesting to see how they altered their discussion from the actual problematic situation presented in the scenario, to a discussion about their own relation to PBL.

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That the scenario ended with a fairly concrete task for the group to work on was not a problem, this despite the fact that this is a conflict with the PBL methodology. Summing up the students' comments during the evaluation session we find that this type of scenario should work as a good way to introduce and engage students to work with different problematic situations. They emphasized that this was certainly a promising alternative to the traditional paper based vignettes they had worked with so far.

5.2 Observing the Industry Group

The setting for the second evaluation was a team room at an industrial plant. The team room had a large conference table, some smaller tables and a table with a computer equipped with a large screen. Only four people from different teams were able to participate. The facilitator for the group belonged to a different department of the company. She received some instructions in advance about the role and purpose of the team leading she was about to enter. The team received a more extensive introduction to the task than the student group. The basics of PBL were explained as a background. They started out quietly, much like the first group. They hummed after they had read through the text in the information scenes and the person with the mouse clicked on to the next. The work was methodological and gave the impression of being very efficient. When they reached the first interactive scene about whether work practice really had changed the group started a quiet discussion. The discussion escalated after a little while and they penetrated the alternatives, and agreed on one alternative. The facilitator was successful in trying to get everyone's opinions. The group felt a bit more at ease and started to use the supplied drawing and writing material to articulate and explain their standpoints. When the group reached the actual task about suggesting an introduction program for new project members an extensive discussion was taking place. They finished their work and presented a draft of an introduction program for new project team members.

The team had no problem in moving through the interactive case. They recognized the issues raised in the scenario. Smiles and laughter were frequent as they moved through the scenario. The group agreed that the format was good in that they were introduced to a problematic situation in a stimulating way, and the team was presented with a task to complete. They found that the embedding of the instruction in the scenario was helpful. Similarly to the student group, they were not sure that additional multimedia content would automatically add to this type of scenario.

6. Discussion

Observing the students work with the scenario it is obvious that this type of alternative vignette add to the process of PBL. The student group focused on the intended issues before they reached the end of the scenario. The group stopped at the interaction scenes and discussed the situation, they reflected and analyzed the situation to understand and problematize. We did not get the feeling that they were rushing to move on in the scenario. A very important observation is that they clearly spent more high quality time with this vignette than when working with a traditional paper based one.

The industry team found a lack of structure in the scenario. This is a very delicate problem to approach. On the one hand, the scenario must not be too superficial and put words in the participants mouths. The scenario should guide the group, but not control them. On the other hand, and from the company's perspective, the aim or the expected outcome must be very clear. PBL was seen as a somewhat 'unstructured' approach, as the group, according to PBL, defines their own problem.

7. Conclusion

An interactive prototype about project management was designed. The prototype was evaluated in two different settings. The three research questions below guided the research and serve to summarize the findings.

- *How can interactive multimedia enhance problem based learning?*

The evaluation suggests that interactive multimedia have large potential in enhancing the first phase of PBL.

- *How can experiential learning and problem based learning be integrated in a methodology?*

We propose a tentative methodology, PIE (Problem based learning, Interactive multimedia and Experiential learning), which is outlined in [Tab. 1] below. PIE is a three phase methodology for structuring educational activities in modules, using interactive multimedia as an important part.

Phase 1.	Experience. The group experience the interactive case facilitated by an instructor. The instructor ensures that the group reaches the end of the scenario and leave the session with the problem on their mind. Duration two hours.
Phase 2.	Reflection. Duration one week
Phase 3.	Feedback and discussion. The group meets together with the instructor and discusses the problem presented in the interactive case. Duration two hours.

Table 1: PIE Framework and Methodology

- *Can interactive multimedia vignettes be used outside a formal education system to train and educate in project management related issues in corporate training programs?*

PIE is an approach that is useful in organized corporate training about for instance project and project management related issues.

While the findings so far are tentative, we argue that the evaluation showed us some important things about the design of vignettes, both traditional and multimedia. The main limitations of this research, as we see it, are two. First, the very simple prototype designed to implement our idea about interactive multimedia vignettes. The vignette used as example in this research is currently being transferred to a web-based interactive multimedia application. Second, the limited evaluation conducted. However, as our aim with this paper is to discuss the problem of challenging learners in a PBL setting, and suggest how these problems can be handled, we do not find these limitations to be problematic for our purposes in this paper.

8. References

[Bieber and Kimbrough 1992] Bieber, M. P. and Kimbrough, S. O. (1992). "On Generalizing the Concept of Hypertext." MIS Quarterly **16** (1): 77-93.

[Boud and Feletti 1991] Boud, D. and Feletti, G., Eds. (1991). The Challenge of Problem Based Learning. London, Kogan Page Limited.

[Farrimond 1997] Farrimond, B. (1997). Using Multimedia to Present Case Studies for Systems Analysis. The International Simulation and Gaming Yearbook Volume 5. Eds. P. Saunders and B. Cox. London, Kogan Page Limited: 135-143.

[Gentry 1990] Gentry, J. W. (1990). What is Experiential Learning? Guide to Business Gaming and Experiential Learning. J. W. Gentry, Association for Business Simulation and Experiential Learning (ABSEL).

[Kendall, Kendall et al. 1996] Kendall, J. E., Kendall, K. E., Baskerville, R. L. & Barnes, R. J. (1996). "An Empirical Comparison of a Hypertext-Based System Analysis Case With Conventional Cases and Role Playing." DATA BASE **27** (1): 58-77.

[Kolb 1984] Kolb, D. (1984). Experiential Learning - Experience as the Source of Leraning and development. Prentice Hall. Englewood Cliffs, NJ

[Kolb 1976] Kolb, D. (1976). "Management and the Learning Process." California Management Review **13** (3): 21-31.

[Leidner and Jarvenpaa 1995] Leidner, D. E. and Jarvenpaa, S. L. (1995). "The Use of Information Technology to Enhance Management School Education: A theoretical View." MIS Quartely **19** (3): 265-291.

[Nulden and Scheepers 1998] Nulden, U. and Scheepers, H. (1998). "What about failures? *Suggestions for an alternative computing education activity.*" Failure & Lessons Learned in Information Technology Management 2 (3) .

[Ramsden 1992] Ramsden, P. (1992). Learning to Teach in Higher Education. London, Routledge.

[Slavin 1990] Slavin, R. E. (1990). Cooperative Learning: Theory, Research, and Practice. Engelwood Cliffs, NJ, Prentice Hall.

Collecting Organizational Memory Based on Social Networks in Collaborative Learning

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Abstract: The exploration of social networks is essential to find capable collaborators who can help problem-solving and to augment cooperation between users. This paper describes PeCo-Mediator-II for seeking for a collaborator with the chain of personal connections (PeCo) in distributed organizations. Moreover, this system helps gathering, exploring, and visualizing social networks. The experimental results show that the system facilitates that learners encounter collaborators and develop a new helpful relationship beyond the classroom.

1. Introduction

Recently, opportunities for communication and collaboration via computer networks have immensely been increased in networked organizations (Sproull and Kiesler, 1991). A fundamental problem is how to encounter people who can help problem-solving. We are focusing on the problem of discovering such people through social networks. Social networks are at least as important as the official organizational structures for tasks ranging from immediate, local problem solving (e.g., fixing a piece of equipment), to primary work functions, such as creating collaborative groups (Kautz et al., 1997).

In CSCW (Computer Supported Cooperative Work), researchers are interested in the role of social networks between organizational members. Clement stated that users developed informal collaborative networks to know how to use a new software (Clement, 1990). Then, private networks are important for workers to solve problems by providing helpful information. A number of studies have shown that one of the most effective channels for gathering information and expertise within on an organization is its informal networks of collaborators, colleagues and friends. The networks of helping relationships are called "Help Network"(Eveland et al., 1994). However, the networks are not collected and generally follow work group alignments rather than technical specialization. Therefore, it is significant to use members' interpersonal connections effectively in their activities.

In CSCL (Computer Supported Collaborative Learning), one common component of collaborative learning is the "informal peer-help networks". This notion is compatible with Wenger's communities of learners (Wenger, 1996), where people who share learning goals within an authentic learning environment can develop ties that reinforce learning outcomes. From this viewpoint, Greer et al. (1998) proposed PHelpS (Peer Help System) that supports workers as they perform their tasks, offers assistance in finding peer helpers when required, and mediates communication on task-related topics. On the other hand, our approach focuses on how a system can support both storing and exploring "Personal Connection" (PeCo) in a collaborative learning environment.

A concept of organizational memory is proposed as organizational knowledge with persistence (Conclin, 1992). Answer Garden (Ackerman and McDonald, 1996), and COMES (Ogata et al., 1996b) have been proposed to record and use organizational memory. In an organization, however, information seeking is not straightforward information transfer. Colleagues chose not to go to the channel of the highest quality for information, but rather to go to the channel of heights accessibility (Allen, 1977). Accessibility is concerned with psychological cost that is in the potential lack of reciprocity between giving and obtaining information and so on. PeCo makes it easy to agree to the cooperation and to access information.

W propose PeCo-Mediator-II (Ogata et al., 1996a) for gathering, seeking, and visualizing social networks in a networked organization. PeCo-Mediator-II is a distributed system with a personal database (PeCo-Collector) and a software agent (PeCo-Agent). Every user has the two softwares on the respective site. PeCo-Collector incrementally gathers information on its user's acquaintances and the relationships through watching the exchanges of e-mail. PeCo-Agent moves to colleagues' sites and negotiates with other agents and users to find collaborators. Although the users of both NetNews and e-mail lists are passive to find answers, our system can actively discover collaborators with the chain of personal connection from the user and the collaborators.

2. Overview of PeCo-Mediator-II

Our initial system called PeCo-Mediator (Ogata et al., 1995) is a groupware that allows sharing of PeCo in a group and to search for connections between the user and targets. The users need to share PeCo with the common database of PeCo-Mediator. Although the system was very available in some small groups, it was reluctant in terms of users offering their private information like PeCo into the common database. Also, it is hard for the users to entry personal data of their friends.

When a computer network connects people or organizations, it is a social network. Just as a computer network is a set of machines connected by a set of cables, a social network is a set of people connected by a set of social relationships, such as friendship, co-working, or information exchange (Garton et al., 1997). Computer Mediated Communication (CMC) systems also reduce the transaction costs of initiating and maintaining interpersonal ties (Pickering and King, 1992). Weak ties created by CMC expand the channels of information sources for the individual and have potential for strong ties.

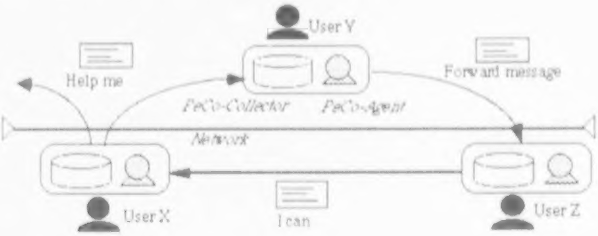

Figure 1. Overview of PeCo-Mediator-II.

PeCo-Mediator-II is combined PeCo-Mediator and on-line social networks. It consists of the two systems; PeCo-Collector and PeCo-Agent (see Figure 1). Every organizational member has the two softwares on the respective site. PeCo-Collector gathers information on its user's acquaintances and the relationships through watching the exchanges of e-mail. PeCo-Agent moves between members' sites to find a partner in the community. The user's PeCo is a starting point for the exploration. The user's acquaintance acts as a liaison between the user and the partner in this situation. In this figure, user X requests user Y to help the problem solving, and user Y introduces user Z. After that, user Z can help user X by request.

3. Gathering Organizational Memory Based on Social Networks

We have proposed a data diagram of PeCo exploration (Ogata et al, 1998). To support the exploration of social networks, it is very important to store the history of PeCo exploration when the user has sent or receive messages. Based on PeCo exploration diagrams, the attribute includes the following user's actions: request, accept, reject, forward, receive-request, receive-forward, receive-accept, receive-reject. The topic of the request is represented with keywords that are extracted from e-mail.

Table 1. Taxonomy of users with the exploration history.

User type	Condition
Collaborator	*accept* > α and *accept* > *reject* and *accept* > *forward* and *accept* > *request*
Mediator	*forward* > α and *forward* > *reject* and *forward* > *accept*
Requestor	*regeust* > α and *request* > *accept* and *request* > *forward*
Non-collaborator	*reject* > α and *reject* > *accept* and *reject* > *forward*
Semi-collaborator	*receive_accept* > α and *receive_accept* > *accept*

(Italic word shows the number of the action. α is a constant given by the user.)

3.3. Taxonomy of Users

Based on the above history, we divide users into the five types (see table 1):

1) Collaborator: The collaborator is a user who usually accepts the request during this system use. The collaborator is often an expert about the request.
2) Semi-collaborator: The semi-collaborator is a user who potentially has the capability for cooperation about the request. We assume that a semi-collaborator receives the answer from others rather than accepting requests.

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3) Mediator: The Mediator is the user who usually forwards the request to his/her friends.
4) Requestor: The requestor is a user who asks a question and s/he becomes a stating point of exploration of social networks.
5) Non-collaborator: The non-collaborator is a user who almost rejects the request.
6) Unknown user: If a user has never received or sent a request, the user is unknown for the system.

PeCo-Agent understands the users' capability through watching the exchanges of questions and answers. We represent the capability of the user and his/her acquaintances with the keywords in the e-mail. For example, a friend is a collaborator about C programming language although the friend is a non-collaborator about Tcl/Tk.

3.5. Collecting Organizational Memory

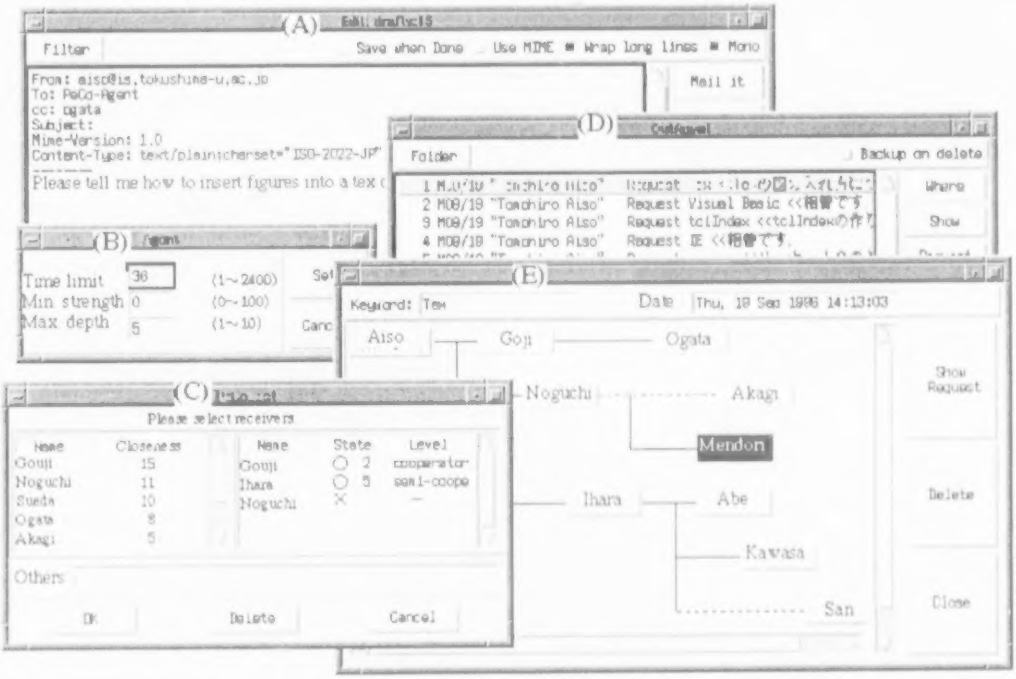
Organizational memory has been proposed as a concept for sharing organizational members' knowledge (Conclin, 1992). We also apply that concept into our situation. If a collaborator permits sharing of an answer, it is entered into a shared repository. Because the requesters can refer to the answers in the database before sending the requests, collaborators need not write down the same answer repeatedly. Moreover, when a collaborator permits propagation of the answer, the system sends the answer to the mediators between the collaborator and the requester as well as the requester. By this facility, mediators can also know the answer.

4. Implementation

4.1 System Configuration

We developed a prototype system on a workstation with Tcl/Tk (Ousterhoult, 1994). The system consists of PeCo-Collector and PeCo-Agent. Every group user has the two systems on the respective site.

(1) PeCo-Collector: This system has two components: data management and E-mail handler. All the data is managed by TRIAS (Yamamoto et al., 1989) and the e-mail tool is TkMH based on MH (Mail Handler) (Peek, 1994). PeCo-Collector links an e-mail object and its sender's or receiver's object automatically and the user can make hypertext links among e-mails.



```
From: aiso@is.tokushima-u.ac.jp
To: PeCo-Agent
cc: ogata
Subject:
Mime-Version: 1.0
Content-Type: text/plain;charset="ISO-2022-JP"
------
Please tell me how to insert figures into a tex
```

Time limit 36 (1~2400)
Min strength 0 (0~100)
Max depth 5 (1~10)

Please select receivers

Name	Closeness
Gouji	15
Noguchi	11
Sueda	10
Ogata	8
Akagi	5

Name	State		Level
Gouji	○	2	cooperator
Ihara	○	5	semi-coope
Noguchi	×		—

Others

OK Delete Cancel

```
2 M08/19 "Tomohiro Aiso"   Request Visual Basic <<[illegible]
3 M08/19 "Tomohiro Aiso"   Request tclIndex <<tclIndexの[illegible]
4 M08/18 "Tomohiro Aiso"   Request IE <<[illegible]
```

Keyword: Tex   Date Thu, 18 Sep 1996 14:13:03

Figure 2: Screen shot of PeCo exploration with PeCo-Mediator-II.

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(2) PeCo-Agent: The characteristics of PeCo-Agent are:

1) To represent capability of users with keywords about e-mails;
2) To obtain the capability of users from the user and other agent;
3) To move around the Internet and communicate with other users and agents;
4) To find the candidates of partners concurrently.

In PeCo-Mediator-II, a user communicates and negotiates with others through e-mail. In the same way, PeCo-Agent communicates with other agents with structured e-mail (Malone, 1986). Keywords are extracted with Chasen (Matsumoto, 1997) that is a Japanese morphological analysis tool. PeCo-Agent calculates the similarity between the given question and the stored questions by matching nouns elicited from Chasen filter.

4.2. Interface

Figure 2 shows the interaction after user "aiso" ask a question to his PeCo-Agent. In the window (A) "aiso" writes the request message. In the window (B), the user sets time out for seeking social networks, the minimum strength of PeCo and the maximum steps between "aiso" and the receiver. PeCo-Agent finishes the exploration according to this setting. In the window (C), PeCo-Agent assists "aiso" to decide who is the better receiver of his acquaintances and the user agent provides information about the candidates of the receivers. The window (D) displays the list of the requests that the user has sent.

The window (E) shows the flow of the exploration from he user graphically. This tree is the result of traveling with the connections of "aiso". The icons except "aiso" denote the candidates of partners. The shorter the distance between two icons, the stronger the relationship they have. While the dotted line denotes the receiver has not read the message yet, the solid line shows the receiver has already read it. The black icon means the user has rejected the request. The node icon shows the user has forwarded the message to his/her friends. The leaf and white icon means the user has accepted the cooperation. In this figure, "mendori" refused aiso's request, and "ogata", "abe", and "kawasaki" agreed to his request. "akagi" has not read the message yet. If the user reminds the reply to the request from this window, PeCo-Agent of "akagi" tells him to read the message. From this result, "aiso" is the most familiar to "goji" and can easily access the collaborator "ogata" through the mediation of "goji".

5. Experimental Use

5.1. Users and Tasks

We experimentally tested and evaluated PeCo-Mediator-II in small communities. In this experiment, we arranged 13 master course students (group A) and 94 undergraduate students (group B) who had no relationship with the members of group A at the first stage of the experiment. Only one person, teacher VI, knows all the members of group A and B. They used the prototype system during nine weeks in a class of programming language C. We divided nine weeks into three terms. Teacher VI gave group B some homework every week, for example, making a program of data sorting.

Term 1: In the first three weeks, the system gathered their usual ties. Each group member communicated among the internal group members without the contact of the other group.

Term 2: We allowed group A and B to communicate and collaborate with each other to solve problems. The users solved the given problems through this system without supporting PeCo exploration with history.

Term 3: In this period, we evaluated the function for supporting PeCo exploration with the history that was stored in the term 2.

5.2. Experimental Results

Figure 3 shows the social networks between the users after six weeks from the beginning of this experiment. While the user of group A is indicated by a circle, the user of group B is shown by a square. The thick arrows denote the requested messages from the sender to the receiver. The thin arrows represent the forwarded messages over one time. The weight of the arrow shows how many times e-mail was exchanged from the sender to the receiver. The user VI was a central person and acted as a liaison between group A and B. As shown in this figure, group A and B learned to communicate with each other through the introduction of user VI, although they did not have connections beyond the group. Moreover, most of the requests from group B concentrated on user VI and III, and the collaborators were almost fixed at six persons of group A. In this case, there was no collaborator in group B.

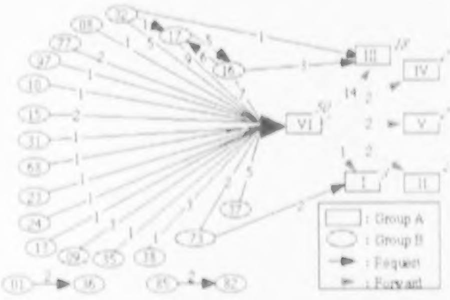

Figure 3. Network forming in the term 2.

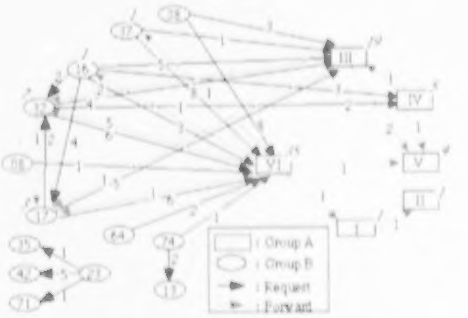

Figure 4. Network forming in the term 3.

In the previous experiment (Ogata et al., 1998), we compared this system with e-mail, mailing list and NetNews during four weeks. This experiment was executed in the same class. Both mailing list and NetNews were not often used for getting answer, because the student hesitated to ask a question. On the other hand, both this system and e-mail were frequently used. In this case, social networks were stable because direct and explicit relationships were used to get collaborative help. Likewise, (Yamakami, 1995) describes the interaction patterns of e-mail and bulletin board are stable from the long-term usage observation.

Figure 4 depicts the message flow in the term 3. Some of group B became collaborators because our system lead the users to reduce the incipient collaborators' load. For example, the system recommended user VI to forward the request from user 32 to user 17 who was a semi-collaborator. After that, user 32 directly requested user 17 to cooperate with problem solving.

In the term 3, the users provide their knowledge into the shared repository. Figure 5 shows the bar chart of its usage every week. The times of reference were 200, and the times of entry were 21. The number of knowledge in the repository was small, but the knowledge was basic. Therefore, the users often made use of it. As a result, the overload of collaborators was reduced.

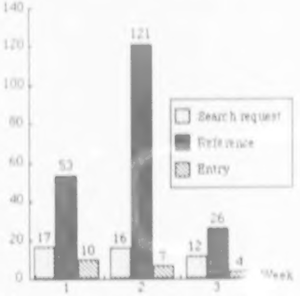

Figure 5: The usage of the shared knowledge repository in term 3.

6. Related Works

There are many possible sources for determining direct relationships. The initial version of our system imposed the entry of relationship lists upon organizational members (Ogata et al., 1995). The provision of individual ties makes the burden heavy for the users. Schwartz and Wood (Schwartz and Wood, 1993) proposed a way to obtain relationships by analyzing e-mail logs. However, the use of such information raises concerns of privacy and security that are hard to allay. ReferralWeb (Kautz et al., 1997) system uses the co-occurrence of names in close proximity in any documents publicly available on the Web as evidence of a direct relationship. Although this system is readily available to discover public relationships,it may be difficult to find real private networks. Our system focuses on current and personal ties based on the exchange of e-mail.

Foner (Foner, 1995) proposes Yenta that is a matchmaker agent to bring people together. In this approach, a broker agent automatically introduces other agents and people. On the other hand, our work pays much attention to human-centered approach for enhancing cooperation between organizational members. Therefore, the agency of PeCo-Agent is weak.

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7. Conclusion

This paper proposed PeCo-Mediator-II as a support to find capable collaborators with the chain of personal connections (PeCo) in a collaborative learning environment. This system helps gathering, seeking, and visualizing social networks of organizational members. PeCo-Mediator-II is an agent-based system to deal with e-mail. This system consists of PeCo-Collector as a personal database and PeCo-Agent as a user's assistant. PeCo-Mediator-II was experimentally tested and evaluated in a C programming language course. The results showed the system could help the user to encounter a collaborator and developed the new relationship with the collaborator.

References

Ackerman, M. S. & McDonald, D. W. (1996). Merging Organizational Memory with Collaborative Help, *Proc. of CSCW 96*, ACM Press, pp.97-105.

Allen, T. (1977). *Managing the Flow of Technology*, MIT Press.

Clement, A. (1990). Cooperative Support for Computer Work: A Social Perspective on the Empowering of End Users, *Proc of CSCW* 90, ACM Press, pp.223-236.

Conclin, E. J. (1992). Capturing Organizational Memory, *Groupware 92*, pp.133-137.

Eveland, D. J., Brown, W. & Mattocks, J. (1994). The Role of "Help Networks" in Facilitating Use of CSCW Tools, *Proc. of CSCW 94*, ACM Press, pp.265-274.

Foner, N. L. (1995). Clustering and Information Sharing in an Ecology of Cooperating Agents, *Proc. of AAAI Spring Symposium on Information Gathering from Distributed, Heterogeneous Environments*, AAAI Press/

Garton, L., Haythornthwaite, C., & Wellman, B. (1997). Studying On line Social Networks, Journal of Computer Mediated Communication, vol.3, no.1. (http:// www.usc.edu/dept/ annenberg/vol3/ issue1/ garton.html)

Greer, J., McCalla, G., Collins, J., Kumar, V., Meagher, P. & Vassileva, J., (1998). Supporting Peer Help and Collaboration in Distributed Workspace Environments, *International Journal of Artificial Intelligence in Education*, 9. (to appear)

Kautz, H., Selman, B. & Shah, M. (1997). The Hidden Web, *AI Magazine*, vol. 18, no. 2, pp.27-36.

Malone, T. W. (1986). Semi-Structured Messages are Surprisingly Useful for Computer Supported Coordination, *Proc. of CSCW 86*, ACM Press, pp.102-114.

Matsumoto, Y, Kitauchi, A., Yamashita, T., Hirano, Y., Imaichi, O. & Imamura, T. (1997). Japanese Morphological Analysis System ChaSen Manual, *Nara Institute of Science and Technology Technical Report NAIST-IS-TR 97007*. (in Japanese)

Ogata, H., Yano, Y., Furugori, N., & Jin, Q. (1995). PeCo-Mediator: Development and Modeling of a Supporting System for Sharing and Handling Personal Connections, *Transactions on Information Processing Society of Japan*, vol. 36, no. 6, pp.1299-1309. (in Japanese)

Ogata, H., Goji, A., Jin, Q., Yano, Y. & Furugori, N. (1996a). Distributed PeCo-Mediator: Finding Partners via Personal Connections, *Proc. of 1996 IEEE Systems, Man and Cybernetics (SMC)*, vol. 1, Beijing, China, pp.802 - 807.

Ogata, H., Tsutsumi, K., Jin, Q., Yano, Y. & Furugori, N. (1996b). COMES: Collaborative Organizational Memory System, *Proc. of IEEE Systems, Man and Cybernetics (SMC)* , vol. 2, Beijing, China, pp.983-987.

Ogata, H., Aiso, T., Furugori, N., Yano, Y. & Jin, Q. (1998). Computer Supported Social Networking in Virtual Communities, *Proc. of IEEE International Conference on Intelligent Processing Systems*, pp.47-51.

Ousterhoult, J. (1994). *Tcl and the Tk Toolkit*, Addison-Wesley.

Pickering, M. J. & King, L. J. (1992). Hardwiring Weak Ties: Individual and Institutional Issues in Computer Mediated Communication, *Proc. of CSCW 92*, ACM Press, pp.356-361.

Peek, D. J. (1994). *MH and XMH: E-mail for users and programmers*, O'Reilly and Associates, Inc.

Salomon, G. (1992). What Does the Design of Effective CSCL Require and How Do We Study Its Effects?, *ACM SIGCUE Outlook*. (http:// www.cica.indiana.edu/ cscl95/outlook/ 62_Salomon.html)

Schwartz, F. M. & Wood, M. C. (1993). Discovering Shared Interests Using Graph Analysis, *Communications of ACM*, no.36, vol.8, pp.78-89.

Sproull, L. & Kiesler, S. (1991) *Connections: New ways of working in the networked organization*, MIT Press.

Wenger, E. (1996). Communities of Practice: The Social Nature of Learning, *HealthCare Forum Journal*, pp.20-26.

Yamakami, T. (1995). Information Flow Analysis: An approach to evaluate groupware adoption patterns, *Transactions of Information Processing Society of Japan*, vol.36, no.10, pp.2511-2519.

Yamamoto, Y., Kashihara, A., Kawagishi, K., & Tsukamoto, S. (1989). A tool for construction of personal database: TRIAS, *Transactions of Information Processing Society of Japan*, vol.30, no. 6, pp.733-742 (in Japanese).

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SmartSearch: Built-in Algorithms Derived from Experiments

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Abstract: Search Engines work very powerfully these days. From the viewpoint of developing/improving meta-search engines, we conducted experiments on available search engines over two years. This paper reports the results of our experiments, and discusses the built-in algorithms and future features of SmartSearch. The University of Tokyo and the United Nations University jointly developed the "Virtual University (VU)" project, whose purpose is to research the effective educational methods in distant learning. SmartSearch is a core search engine in the project and will be served in most of the components of the VU.

1. Introduction

The Internet is growing at the speed of light. Just a decade ago, only a small percentage of the population was trying the BBS system using very slow modems. Thanks to the reduction in price of the computers whose average prices are under $1000 now, the latest figure shows that one out of every two families in the US have computers. They use it for word-processing, spreadsheet, games, finances, etc. However, the main reason of this rapid permeation must be the popularity of the Internet.

E-mails are very popular among people because of their convenience and fast delivery. The sender does not need to worry about the availability of the receiver unlike phones, even though the letter will arrive in a minute unlike postal letters. Web pages are also convenient because of their abundant information. No encyclopedia has 100 million pages of information. The only problem with this information source is its unorganized structure, rather we should say it does not have any structure at all. If the information is scattered around, we cannot reach the desired one.

To solve this problem, search engines were invented. The first one was called Web-Directory-Service Search Engine, which listed all web pages that the users registered. This process was done by people, not programs, and took a lot of time. This method ended up falling behind the growth of the Internet. The second method was called Robot-Driven Search Engine, which sent robots/spiders to all web servers to retrieve all HTML files available. This is processed by only programs, assuring speed, but not relevancy. Both types basically match keywords with their databases. Some of them have more effective methods to improve the accuracy of the results. Still, we are not satisfied with the results of these search engines due to their inaccuracy and bothersome dead-links.

2. Meta-Search Engine

Here, the Meta-Search Engine came up. Meta-search engine is a new kind of search engine that uses both previous conventional search engines in the background. It sends the keyword to them, and retrieves the results. After re-ordering the links, it shows the result to the user.

The key point of the meta-search engine is this re-ordering technique. The technique is different in each meta-search engines, and of course, SmartSearch that we programmed has its own algorithms. Although some kinds of meta-search engines just output the results without processing much in depth, SmartSearch's algorithms are based on the results of our experiments on conventional search engines two years ago. The reason for conducting the experiment is to increase our knowledge of the factors to the accuracy. Needless to say, the connection of the results of conventional search engines with the results of the meta-search engines was unknown.

3. Past Experiment

As seen in the reference section, people have experimented and publicized the evaluation of the search engines. Here, the purpose of this experiment was not to rank conventional search engines, but to find an effective way to utilize the conventional search engines. Two years ago, not many search engines were powerful enough to output the results in a short amount of time, nor did they have a large enough database to hold all HTML documents in the Internet. Due to these restrictions, we limited the experiment to six search engines: four robot-driven search engines, one directory-service search engine and one meta-search engine. We keyed in keywords, took basically ten result links, went over to the pages, viewed and evaluated whether the pages were relevant to the topic. This evaluation process was conducted by three members, two of which should have agreed that the page has a strong connection to the topic for the results to be considered as *relevant*. *Total* means the total number of links, *Dead* means dead-links, and *repeats* means repeated links, whose information is exactly the same but resides in a different web server (mirror servers) in most cases. We excluded any page written in other than English as *non-English*, since the keyword is English and we conducted the experiment for the search engines that locate in the US.

We tried to spread the topics into as many areas as possible. Some of them are from the academic area while others are from a recreational area; Some are for business while some are for private. We decided to conduct this experiment using the following topics:

- Dilbert
- health care
- IPV6
- TWA (Trans World Airline)
- Vijak Sethaput (private name)
- Wall Street Journal
- "1996 presidential election" & Clinton & Dole
- "Fermat's Last Theorem" & proof
- Macarena & dance
- Mars & rock & (life | creature) & NASA
- Atlanta & "olympic games"
- Ransom & "Mel Gibson"
- "United Nations" & "Peace Keeping Force"

The results of the experiment are summarized in [Tab. 1]. The raw data of the experiment are available at http://www.smartsearch.org/se_experiment.html

Table 1: Dec. 1996

SEs	Total	dead	relevant	repeats	non-English	Score for people	Score for MSE
AltaVista	9.54	1.23	4.85	0.00	0.23	0.51	0.56
Excite	9.77	0.62	6.46	0.08	0.23	0.63	0.70
HotBot	10.00	0.38	6.69	0.38	0.38	0.59	0.65
Lycos	8.46	0.85	4.54	0.00	0.23	0.56	0.61
Yahoo	7.54	0.38	4.15	0.23	0.08	0.47	0.51
MetaCrawler	9.62	0.54	5.69	0.08	0.15	0.58	0.62
avg	9.15	0.67	5.40	0.13	0.22	0.56	0.61

In the above, *Score for people* are calculated as:

$$\frac{relevant - repeats - nonEnglish}{Total}$$

The reason for using this equation is that we do not want repeated information or non-English information even if they are relevant. Therefore, this score is what the user would feel about the results from each search engine.

First, we would like to analyze this result from the viewpoint of human user. We specified the search engines to output the Top 10 links. We believe these ten links are the maximum for most users to check since this task is very time-consuming. There is a great possibility that the relevant links may have appeared in the next 100 links since some search engines show that they have more than a thousand of links relevant. However, it is impossible for us to check all of these returned links, nor any user would do when they search. From this special character of the abundant information on the Internet, we did not (could not) calculate the

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generally known figures: precision rate and recall rate.

The figures of the dead-links show that 5-10% of the returned links are unavailable. Also, the figures of repeated links consist a few percentage of the total figure. If these figures are too large as shown here, users will feel "Search Engines are useless!" Information in particular language can be useful for people who speak that language, but not for everyone, considering the fact that most information on the Internet is written in English and resides on the US-based web servers.

The *Score for Meta-Search Engines* are calculated from different perspective.

$$\frac{relevant - \frac{1}{2} repeats - nonEnglish}{Total - dead - \frac{1}{2} repeats}$$

This score is calculated based on the algorithms used by SmartSearch. When SmartSearch receives the results from conventional search engines, it checks whether the links are active or not, deletes repeated links if mirror servers are found. However, when titles and/or contents are slightly different, SmartSearch cannot delete repeated link even when it looks almost similar to the human users. We put this rate of able/unable to delete repeated links to be 50% each, which is a experimental figure we got. As a result, the number of links to be analyzed further will be decreased from *Total*.

The number of relevant links is also decreased by a half of the repeated links, because of the process above. Looking at [Tab.1], the relevancy score has increased by 4-7% compare to the one for people. This means, the above simple algorithm can increase the relevancy rate very easily. Based on this result, SmartSearch decided to use Excite and HotBot as the background search engines for a time being.

4. Experiment on Current Search Engines

We conducted the experiment again two years later. Generally speaking, search engines have improved its relevancy rate dramatically in the past two years, which is shown in [Tab. 2]. Another change is the purpose of search engines. Today, search engines do not exist as it used to be. They try to change_its style to be "portal site" which is the starting point to any kind of information for the user. In this changing process, a lot of search engines begin to hold their own listing of business/news information to encourage users to set their homepage as the default for web browsers. Interestingly, not all of them are searchable, nor they list a lot of information.

We used ten search engines for evaluation at this time: six robot-driven search engines, one directory-service search engine and three meta-search engines. We conducted this experiment with the same policy and methods, but changed some of the topics to the following:

- Dilbert
- health care
- IPV6
- TWA (Trans World Airline)
- Vijak Sethaput
- Wall Street Journal
- "1996 presidential election" & Clinton & Dole
- "Fermat's Last Theorem" & proof
- Macarena & dance
- IOC & bribe & investigation
- Titanic & movie
- "United Nations" & "Peace Keeping Force"

The analysis of the change of these topics will follow in the next chapter.

The results of this experiment are summarized in [Tab. 2]. The raw data of the experiment are available at http://www.smartsearch.org/se_experiment.html

Table 2: Feb,1999

SEs	Total	dead	relevant	repeats	non-English	Score for people	Score for M SE
AltaVista	10.00	1.17	6.75	0.58	0.25	0.59	0.72
Excite	10.00	0.42	8.67	0.33	0.17	0.82	0.88
HotBot	9.92	0.25	8.75	1.08	0.33	0.74	0.87
Lycos	10.00	1.50	6.83	0.58	0.33	0.59	0.76
Infoseek	10.00	0.58	8.50	0.83	0.25	0.74	0.87
WebCrawler	9.33	0.25	7.92	0.17	0.25	0.78	0.82
Yahoo	8.83	0.83	6.75	1.08	0.17	0.62	0.82
MetaCrawler	10.00	0.92	7.83	0.33	0.17	0.73	0.84
Sherlock	10.00	0.83	8.00	0.58	0.17	0.73	0.85
SmartSearch	9.33	0.00	8.58	0.33	0.17	0.86	0.89
avg	9.74	0.68	7.86	0.59	0.23	0.72	0.83

This new figure shows interesting phenomena. The number of dead-links and the number of non-English pages have not changed a lot, while the number of repeated links have increased tremendously. The scores for people and meta-search engines have both increased.

Analyzing the results, we can conclude the following facts:

The search engines are still slow to update all their databases that resulted in the number of dead links. The dead-links are usually considered as the time-rug between the time user accessed and the time when robot-driven search engines collected the information.

The rate of non-English pages stayed the same. It implies that a low percentage of non-English speaking people have bought and got used to use computers to access to the Internet. This results is quite interesting, since newspapers say more and more computers are sold in the world, but it seems to be that the computers are basically for business use in non-English speaking countries.

The increase of repeated links tells that people begin to put their pages on several servers to assure the publicity of the information. If more pages with the same contents are on the Internet, it is more likely that other people will come up and view the pages. Although this expectation is not exactly correct as most readers already know, this figure shows that at least more people try to broadcast their information than they did two years ago.

In all search engines, the score for people/meta-search engine have increased. We found this figure and felt happy since SmartSearch is dependent on the relevancy rate of the conventional search engines. As we have observed two years ago, the use of search engines that do not perform well will limit the capability of the meta-search engines. However, comparing to the situation from two years ago, all conventional search engines have become useful.

5. The Changes Over Two Years

It is very interesting to see the change of the quality and quantity of the results returned from conventional search engines. An information about a certain topics from two years ago still remains, while the other topics have become extinct. Generally, we consider that the news topics will die out quicker since most articles from newspaper companies' web sites will be updated or deleted. This is an understandable relationship.

How about academic findings? We expected that people have publicized deeper analysis of the information, for example "the rock found on Mars which contains a trace of life." However, it turned out to that the most of the past information about this topic has just died out, and that is why we did not use this topic for conducting a new experiment. On the contrary, in the case of "the proof of Fermat's Last Theorem," the quantity of the information has increased. It looks like the topic about the rock was just news materials not academic.

The latest news like "the bribe suspects of IOC members" are easily found by robot-driven search engines today. This result also fortifies our hypothesis about the previous relationship.

Recreational and company information stayed over time. This fact implies that people's interests have not changed as quickly as news issues. From the point of view of meta-search engines, it is very difficult to often modify internal algorithms to catch up with the changing news-related matters, and therefore, meta-search engines should concentrate on improving matters of common interest.

6. Algorithms of SmartSearch

Unfortunately, MetaCrawler did not achieve a good record unlike what we expected. When we observed the results of MetaCrawler, we noticed most of the non-relevant links were originally from the search engines that did not perform well. The Sherlock, dramatically introduced with MacOS8.5, also depends on one search engine even though it uses several search engines. It is easily concluded that if meta-search engines are smart enough to exclude irrelevant links, the output will improve tremendously.

From this observation, SmartSearch limits its use of the conventional search engines, and only focuses on the high-relevancy rate search engines. We believe that this policy will increase the result scores, coupled by the following algorithms. SmartSearch downloads actual HTML documents and analyzes the relevancy for the user.

- *The number of keywords appearing in the title*
- *The number of keywords appearing in the main text*
- *The number of keywords appearing in the URL*
- *The relevancy information returned from conventional search engines*
- *The number of URLs which share the same web server*
- *Whether or not the keywords have jargon which can specify the area the user is looking for*
- *The host type (e.g. edu, com, net, etc.)*
- *The type of search engine which returned the link*
- *The length of the URL*

The result of [Tab. 2] shows that SmartSearch performs best in the *Score for people*, which we believe to be the best method to evaluate the results. The process to delete dead-links and repeated links decreased their numbers, which brought the total score to this point.

One of the algorithms to be implemented in the future, derived from the new experiment, is to deal with the common interest of the human being, which does not change easily over time. The jargon keywords will specify the area to be searched, and more precise analysis of the common interest will enable us to specially tune SmartSearch for that area.

7. Application on Virtual University

SmartSearch prohibits its commercial use by only allowing its use to the people who would like to facilitate our efforts to improve the engine; this results in supporting the Virtual University project. The Virtual University project is held by The United Nations University, jointly supported by the University of Tokyo. The purpose of the project is to develop the study environment for all students in the world (e.g. the Virtual Classroom and the Digital Library).

SmartSearch is a core component of the Virtual University to enhance its ability to accumulate and search information. Although digitized books are limited in quantity, SmartSearch can offer more information from the abundant information source of the Internet. Also, SmartSearch will be specially modified for its use in the Virtual Classroom, where students can refer to other students' notes or explanations by teachers.

We are implementing the sub-SmartSearch program in several areas of use. The Virtual Classroom and the Digital Library should have different models of search engines specially designed for their use. In the future, we are going to develop sub-SmartSearches for every single academic area, and call the total system "SmartSearch."

8. Conclusion & Future Work

In this paper, we conducted the experiments of search engines twice over two years, and summarized the analysis of the results from the point-of-view of developing meta-search engines. Fortunately, our SmartSearch achieved high scores in several areas. The ideas derived from the new experiment suggest a need for more precise analyses of the common human interest, which should improve the relevancy of the SmartSearch program's output.

To be used as a core component at the Virtual University, SmartSearch also needs to be specially designed for academic-specific use. The current model of meta-search engines on the Internet should help us spot the unknown problems easier, and enhance SmartSearch's ability as a search engine for any use.

9. References

[Chong 98] Chong, Ng S. T. (1998). The Virtual University - Promises, Challenges, and Trends. *1998 Shanghai International Open and Distance Education Symposium.*

[Chong et al. 99] Chong, Ng S. T., Ogino, S. and Sakauchi, M. (1999). Toward a ubiquitous Virtual University. *The 10th International Conference on College Teaching and Learning.* [On-line].
Available: http://www.smartsearch.org/ogino/papers/VU.html

[Ogino 98] Ogino, S. (1998). SmartSearch: a new breed of Meta-Search Engine. *handouts at UNESCO HEIC98.*

[Ogino 99a] Ogino, S. (1999). Experiment of Conventional Search Engines and Comparison with SmartSearch. [On-line].
Available: http://www.smartsearch.org/se_experiment.html

[Ogino et al. 99b] Ogino, S., Chong, Ng S. T. and Sakauchi, M. (1999). SmartSearch as Information Database for Virtual University. *Proceedings of ED-MEDIA99.* [On-line].
Available: http://www.smartsearch.org/ogino/papers/edmedia99.html

[Selberg & Etzioni 98] Selberg, E. and Etzioni, O. (1998). Multi-Engine Search and Comparison Using the MetaCrawler. *Forth International World Wide Web Conference Proceedings*, 195-208.

Toward Web-site Quantitative Evaluation: Defining Quality Characteristics And Attributes

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Abstract racteristics and attributes grouping them in a hierarchy. The primary goal is to classify the elements (regarding standards) that might be part of a quantitative evaluation and comparison process. In order to effectively select quality characteristics we should consider different users' needs and behaviors. Hence, we outline more than sixty directly measurable attributes regarding the visitor standpoint and site domains that could range from museums and academic sites to electronic commerce domain. Also, we discuss some metrics and we show the big picture of the Web-site Quality Evaluation Method. The results should be useful to understand, assess, control, and improve the quality of Web-based software artifacts.

1. Introduction

The sudden irruption of the Web around the world has marked a quick growth in the developments of Web-based artifacts. However, as elsewhere stressed [Olsina 98a, Rossi 96], much defined models that leverage the development and the evaluation activities, mainly in medium and large-scale projects, have not been accompanied by that sites growth. Thus, the need of having an engineering approach to help in the understanding, evaluation, and improvement of Web-based software products should be considered a mandatory requirement. One objective for Web-site evaluation is to find out the extent which a given artifact characteristic or set of characteristics fulfills a selected set of requirements regarding a specific user view. Therefore, in this way, evaluation implies a logical decision-making process.

Evaluation methods and techniques fall in two categories: qualitative or quantitative. Even if software evaluation has more than three decades as discipline, the systematic and quantitative quality evaluation of hypermedia application and particularly of the Web sites is rather a recent and often neglected issue. The authors in [Garzotto et al 97] have introduced some evaluation criteria like richness, consistency, among others, to evaluate in a qualitative way hypermedia application. However, this approach is only well suited when the evaluation problem is rather simple and intuitive. In cases with many elementary attributes, it is difficult to evaluate accordingly and it is hard to identify minor differences between similar comparative systems.

Moreover, in the last three years Web-site style guides and design principles have emerged to assist developers in the process [IEEE 99, Nielsen 99, Rosenfeld et al 98], and also, list of guidelines that author should follow in order to make sites more accessible [W3C 99]. These guidelines and techniques have brought insight about essential characteristics and attributes and might improve the Web-site designing process but, obviously, do not constitute evaluation methods by themselves. In addition, quantitative surveys [Nielsen 99] and domain-specific evaluations for electronic commerce have recently emerged [Lohse et al 98]. Specifically, Lohse & Spiller identified and measured over 30 attributes that influence store traffic and sales. However, we need a broad and engineering-based method to assess complex quality requirements.

The aim of this work is to classify, in a standard-compliant way [IEEE 92, ISO 91], characteristics and attributes that might be part of a quantitative evaluation process. In order to effectively select quality characteristics we should consider different kind of users. We represent many characteristics and sub-characteristics, and more than sixty measurable attributes regarding the visitor standpoint and domains that could range from presentation and academic sites to electronic commerce domains. In addition, we explain some elementary evaluation criteria. The results of applying the proposed method (Web-site Quality

Evaluation Method) might contribute to understand, and potentially improve the sites' quality.

Therefore, in the following section, we present the main activities that evaluators should perform by applying the Web-site QEM. Next, we represent characteristics and attributes regarding the general visitor viewpoint and we show some metrics. Finally, we consider concluding remarks and future directions.

2. Overview Of The Web-Site QEM

In order to effectively select quality characteristics and attributes we should first consider the site domain, evaluation goals, and different stakeholders' requirements. After considering these steps, the primary objective is to group characteristics and attributes that might be part of the evaluation and comparison process. So, to get insight of the overall process we outline and describe the main steps that the evaluators should follow by applying the Web-site QEM, namely:

- *Selection of the Site Domain to Evaluate or Compare*
- *Specification of Goals and User Standpoint*
- *Definition of Quality Characteristics and Attributes*
- *Definition of Attribute Evaluation Criteria, and determination of Elementary Preferences*
- *Aggregation of Elementary Preferences to yield the Global Quality Preference*
- *Analysis and Comparison of Partial and Global Quality Outcomes*

Step one. *Selection of the Web Information System domain:* first, the evaluators should know what would be the software domain to evaluate or compare. For instance, regarding WIS or sub-systems we should emphasize more usability than security characteristic or both, depending on the specific situation. In electronic commerce, security is an essential characteristic, but in an academic site is less important. Besides, if the goal is to perform a case study to compare the quality of sites, we should select the typical ones in order to be successful throughout the process.

Step two. *Specification of Goals and User Standpoint:* in this activity, the decision-makers should define the goals and scope of the evaluation process. The results might be useful to understand, control, or improve the quality of Web artifacts. The evaluators could evaluate a new running or an operational project, the quality of a subsystem, a whole system, or compare global preferences of competitive systems. On the other hand, the relative importance of quality characteristics varies depending on the different users. Therefore, we define user views (as we will see in the next section).

Step three. *Definition of Web-site Quality Characteristics and Attributes:* in this step, the evaluators should define, categorize, and specify the quality characteristics and attributes, grouping them into a requirement tree. In order to follow well-known standards, the same conceptual characteristics or factors as in [IEEE 92, ISO 91] are used; i.e., Usability, Functionality, Reliability, Efficiency, Portability, and Maintainability characteristics. From these, sub-characteristics are derived, and, in turn, measurable attributes can be specified. For each attribute A_i, a variable X_i is associated taking a real value, i.e., the measured value. That hierarchical decomposition from characteristics in sub-characteristics and measurable attributes could be considered in the software quality metric framework depicted in the IEEE Standard.

Step four. *Definition of the Evaluation Criterion for each Quantifiable Attribute, and perform Elementary Measurement:* in this task, the evaluators should define the basis for elementary evaluation criteria and perform the measurement process. Elementary evaluation criteria say how to evaluate quantifiable attributes. The result is a rating, which can be interpreted as the degree of satisfied requirement. For each variable X_i, $i = 1, ..., n$ it is necessary to establish an acceptable range of values and define a function, called the elementary criterion. This function is a mapping of the variable value (obtained from the empirical domain [Fenton et al 97]) into the new numerical domain and called the elementary quality preference, EQ_i. The elementary quality preference EQ_i can be assumed as the percentage of requirement satisfied by the value of X_i. In this sense, $EQ_i = 0\%$ denotes a totally unsatisfactory situation while $EQ_i = 100\%$ represents a fully satisfactory situation. For each quantifiable attribute, the measurement activity should be carried out.

Step five. *Aggregation of Elementary Preferences to yield the Global Quality Preference:* in this task, the evaluators obtain an indicator of global preference for each competitive system or for a single evaluated system. For n attributes the corresponding function, produce n elementary quality preferences. Applying a stepwise aggregation mechanism, the elementary quality preference can be grouped accordingly, allowing computing the global quality preference. The global quality preference represents the global degree of satisfaction of all involved requirements. (In two case studies we performed, the Logic Scoring of Preference model was used [Dujmovic 96]. The strength of LSP resides in the power to model simultaneity, replaceability, and other attribute relationships using logic aggregation operators).

Step six. *Analysis and Comparison of Partial and Global Quality Outcomes*: in this final step, the evaluators assess the partial and total quantitative quality preferences regarding the stated goals and user standpoint. Thus, specific recommendations can be given to the requester.

3. Representation Of Characteristics And Attributes

3.1 Web-site Quality Characteristics and Attributes Tree

In this section, we focus on defining and categorizing a wide set of Web-site quality characteristics and attributes. Specifically, by applying the third process step the evaluators group characteristics and attributes in a requirement hierarchy. As previously said, we use the same conceptual high-level quality characteristics like *Usability*, *Functionality*, *Reliability*, *Efficiency*, *Portability*, and *Maintainability* to follow well-known standards. These characteristics give a conceptual and general description of software quality and provide a baseline for further decomposition. From these characteristics, we could derive sub-characteristics, and from these, we could specify measurable attributes.

Furthermore, the relative importance of characteristics varies depending on the different users and application domains. According to this, three views of quality are defined, namely: visitor view, developer view, and manager view [ISO 91]. The visitor category can be decomposed, in turn, in two sub-categories: *general visitors* and *expert visitors*. The former represents casual or intentional audience maybe having a general interest and/or minimum domain knowledge; the later represents, a specialist or expert in the domain. In addition, from the visitor viewpoint, quality characteristics such as Maintainability and Portability are not relevant. They are mainly interested in the site ease of use and communicativeness, in its browsing and search mechanisms, in its coherent navigation mechanisms and dependent-domain expected functionality, and also, in the site reliability and efficiency. Thus, in order to assess the Web-site quality, it should be clearly stated the desired combination of characteristics and attributes regarding the intended audience. [Figure 1] outline characteristics, sub-characteristics, and more than sixty measurable attributes regarding the general visitor standpoint and Web domains that could range from museums and academic sites to electronic commerce. Next, we discuss some characteristics and attributes.

The *Usability* characteristic is decomposed in sub-factors such as *Global Site Understandability*, *Feedback and Help*, *Interface and Aesthetic*, and *Miscellaneous Features*. The *Functionality* characteristic is split ups in *Searching and Retrieving*, *Navigability*, and *Specific Domain* issues, and so on. With regard to *Site Understandability*, in turn, we have decomposed it in *Global Organization Scheme*, *Labeling*, and *Guided Tour* sub-characteristics; i.e., features mainly available in a home page and that could remain during sub-site navigation. They contribute to a quick and overall Web-site understanding of both the structure and the content. However, for instance, the *Global Organization Scheme* factor is still too general to be quantifiable; many attributes could be grouped in this sub-characteristic. Hence, we decompose it in attributes like *Table of Content*, *Site Map*, etc. so that, finally, are measurable.

By considering a specific domain we easily might see that no necessarily all attributes should exist simultaneously; it can be necessary a *Site Map*, or a *Table of Content*, or an *Index*. Moreover, for example an index type could be replaceable according the domain. Subject-oriented indexes can be better in some circumstances than chronological-oriented indexes; besides, more than one index type could stay at any moment. (Web-site QEM allows to model simultaneity and replaceability relationships taking into account weights and levels of and/or polarization). Likewise, we can model simultaneity relationship in the *Web-site Search Mechanism*. For a given visitor view, it can often be better counting with both scoped and global search; i.e., it can be necessary a customized *Scoped Search* to search a (museum) collection by author and school as long as a *Global Search* can also be necessary to search general issues. Sometimes, specific areas of a site are highly coherent and distinct from the rest of the site that makes sense to give a scoped (restricted) search to users [Nielsen 99]. However, a basic and advanced global search feature could generally be enough.

In addition, regarding *Reliability* factor, the *Nondeficiency* sub-factor is discussed. That is, the degree to which artifacts do not contain undetected errors [IEEE 92]. In this category and considering *Link Errors*, attributes like *Broken, Invalid, and Unimplemented Links* were selected. The *Broken Links* attribute counts dangling links out of the total site links leading to absent destination nodes. Similarly, the *Invalid Links attribute* counts the founded links that drive into wrong or unrelated nodes; and the *Unimplemented Links* attribute counts links that unexpectedly drive to the same origin node. The higher the detected number of links errors, the lower the site *Reliability*. Consequently, the quality is debased.

1. Usability
- 1.1 Global Site Understandability
  - 1.1.1 Global Organization Scheme
    - 1.1.1.1 *Site Map*
    - 1.1.1.2 *Table of Content*
    - 1.1.1.3 Global Indexes
      - 1.1.1.3.1 *Subject Index*
      - 1.1.1.3.2 *Alphabetical Index*
      - 1.1.1.3.3 *Chronological Index*
      - 1.1.1.3.4 *Geographical Index*
      - 1.1.1.3.5 *Other Indexes (by audience, by format, hybrid, etc.)*
  - 1.1.2 Quality of Labeling System
    - 1.1.2.1 *Textual Labeling*
    - 1.1.2.2 *Iconic Labeling*
  - 1.1.3 Audience-oriented Guided Tour
    - 1.1.3.1 *Conventional Tour*
    - 1.1.3.2 *Virtual Tour*
  - 1.1.4 *Image Map (Metaphorical, Building, Campus, Floor and Room Imagemaps, etc.)*
- 1.2 Feedback and Help Features
  - 1.2.1 Quality of Help Features
    - 1.2.1.1 *Web-site Explanatory Help*
    - 1.2.1.2 *Search Help*
  - 1.2.2 Web-site Last Update Indicator
    - 1.2.2.1 *Global*
    - 1.2.2.2 *Scoped (per sub-site or page)*
  - 1.2.3 Addresses Directory
    - 1.2.3.1 *E-mail Directory*
    - 1.2.3.2 *Phone-Fax Directory*
    - 1.2.3.3 *Post mail Directory*
  - 1.2.4 *FAQ Feature*
  - 1.2.5 On-line Feedback
    - 1.2.5.1 *Survey/Questionnaire Feature*
    - 1.2.5.2 *Guest book*
    - 1.2.5.3 *Comments*
- 1.3 Interface and Aesthetic Features
  - 1.3.1 *Cohesiveness by Grouping Main Control Objects*
  - 1.3.2 Presentation Permanence and Stability of Main Controls
    - 1.3.2.1 *Direct Controls Permanence*
    - 1.3.2.2 *Indirect Controls Permanence*
    - 1.3.2.3 *Stability*
  - 1.3.3 *Style Uniformity*
  - 1.3.4 *Aesthetic Preference*
- 1.4 Miscellaneous Features
  - 1.4.1 *Foreign Language Support*
  - 1.4.2 *What's New Feature*
  - 1.4.3 *User Profile Detection*
  - 1.4.4 *Download Feature*
  - 1.4.5 *Screen Resolution Indicator*

2. Functionality
- 2.1 Searching and Retrieving Issues
  - 2.1.1 Web-site Search Mechanisms
    - 2.1.1.1 *Scoped Search (e.g. Collections, Books, Academic Personnel, etc.)*
    - 2.1.1.2 *Global Search*
  - 2.1.2 Retrieve Mechanisms
    - 2.1.2.1 *Level of Retrieving Customization*
    - 2.1.2.2 *Level of Retrieving Feedback*
- 2.2 Navigation (and Browsing) Issues
  - 2.2.1 Navigability
    - 2.2.1.1 Orientation
      - 2.2.1.1.1 *Indicator of Path*
      - 2.2.1.1.2 *Label of Current Position*
    - 2.2.1.2 *Average of Links per Page*
  - 2.2.2 Navigational Control Objects
    - 2.2.2.1 Presentation Permanence and Stability of Contextual (sub-site) Controls
      - 2.2.2.1.1 *Contextual Controls Permanence*
      - 2.2.2.1.2 *Contextual Controls Stability*
    - 2.2.2.2 Level of Scrolling
      - 2.2.2.2.1 *Vertical Scrolling*
      - 2.2.2.2.2 *Horizontal Scrolling*
  - 2.2.3 Navigational Prediction
    - 2.2.3.1 *Link Title (link with explanatory help)*
    - 2.2.3.2 *Quality of Link Phrase*
- 2.3 Domain Specific and Miscellaneous Functions
  - 2.3.1 Content Relevancy (depending on the domain we should decompose it accordingly)
  - 2.3.2 *Link Relevancy*
  - 2.3.3 Electronic Commerce (valid for some domains. Besides, it can widely be decomposed)
    - 2.3.3.1 Purchase Features
      - 2.3.3.1.1 *Shopping Basket Facility*
      - 2.3.3.1.2 *1-Click Setting*
      - 2.3.3.1.3 *Quality of Product Catalog*
    - 2.3.3.2 *Secure Transaction*
    - 2.3.3.3 *Account Facility*
  - 2.3.4 Image Features
    - 2.3.4.1 *Size Indicator*
    - 2.3.4.2 *Zooming (for museums, campus, etc.)*

3. Site Reliability
- 3.1 Nondeficiency
  - 3.1.1 Link Errors
    - 3.1.1.1 *Broken Links*
    - 3.1.1.2 *Invalid Links*
    - 3.1.1.3 *Unimplemented Links*
  - 3.1.2 Miscellaneous Errors or Drawbacks
    - 3.1.2.1 *Deficiencies or absent features due to different browsers*
    - 3.1.2.2 *Deficiencies or unexpected results (e.g. non-trapped search errors, frame problems, etc.) independent of browsers*
    - 3.1.2.3 *Dead-end Web Nodes*
    - 3.1.2.4 *Destination Nodes (unexpectedly) under Construction*

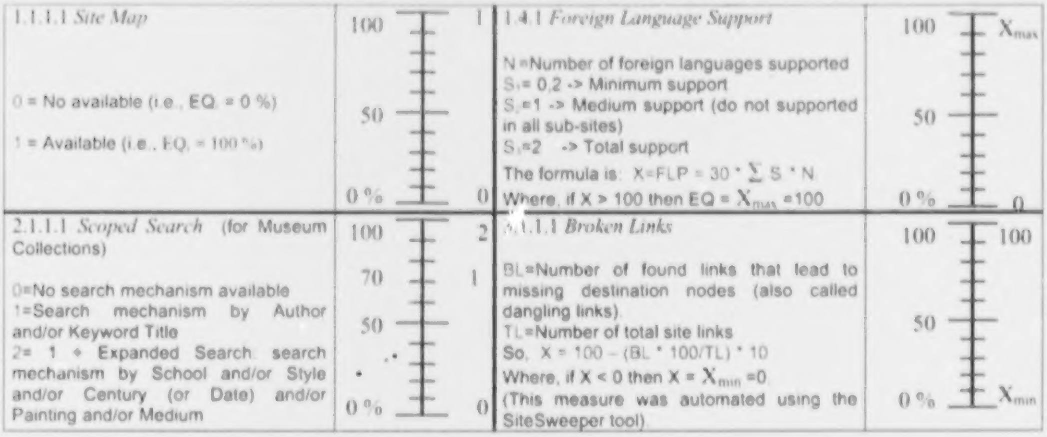
4. Efficiency
- 4.1 Performance behavior
  - 4.1.1 *Page Size*
- 4.2 Accessibility
  - 4.2.1 Information Accessibility
    - 4.2.1.1 *Support for text-only version*
    - 4.2.1.2 Readability by deactivating Browser Image Feature
      - 4.2.1.2.1 *Image Title*
      - 4.2.1.2.2 *Global Readability*
  - 4.2.2 Window Accessibility
    - 4.2.2.1 *Number of panes regarding frames*
    - 4.2.2.2 *Non-frame Version*

Figure 1.

3.2 Some Web-site Attributes And Its Metrics

As said above, for each measurable attribute A_i evaluators can associate a variable X_i, which can take a real value. In addition, for each variable it is necessary to establish an acceptable range of values and define a function, called the elementary criterion function. The result of this mapping is the elementary quality preference, EQ_i. In turn, preferences can be rated in three acceptability levels: satisfactory, marginal, and unsatisfactory.

[Figure 2], shows a set of 4 elementary quality criteria represented by a preference scale. For instance, the evaluation criterion for a *Site Map* attribute is a simple discrete binary criterion: we only ask if it is available (completely satisfactory) or not (completely unsatisfactory). Instead, the evaluation criterion for a *Foreign Language Support* attribute is according to the formula, shown in the right upper side of the figure. The variables considered are the number of foreign languages supported by the Web-site (e.g., for museums), and the level of support (total, partial, or minimum). The resulting value could be between 0 (completely unsatisfactory) and X_{max} (completely satisfactory). If the measured value of X is above X_{max}, the corresponding elementary preference EQ will be equal to X_{max}. (Also, the reader can see the equation in order to obtain the elementary preference for the broken link attribute).



1.1.1.1 *Site Map*

0 = No available (i.e., EQ_i = 0 %)

1 = Available (i.e., EQ_i = 100 %)

1.4.1 *Foreign Language Support*

N =Number of foreign languages supported
S_i= 0,2 -> Minimum support
S_i=1 -> Medium support (do not supported in all sub-sites)
S_i=2 -> Total support
The formula is: $X = FLP = 30 * \sum S_i * N$
Where, if X > 100 then EQ = X_{max} =100

2.1.1.1 *Scoped Search* (for Museum Collections)

0=No search mechanism available
1=Search mechanism by Author and/or Keyword Title
2= 1 + Expanded Search: search mechanism by School and/or Style and/or Century (or Date) and/or Painting and/or Medium

[illegible].1.1.1 *Broken Links*

BL=Number of found links that lead to missing destination nodes (also called dangling links)
TL=Number of total site links
So, X = 100 – (BL * 100/TL) * 10
Where, if X < 0 then X = X_{min} =0
(This measure was automated using the SiteSweeper tool)

Figure 2

On the other hand, the evaluation criterion for a *Scoped Search* attribute is a multi-level discrete absolute criterion defined as a subset, where 0 implies no search mechanism available; 1 implies a basic search mechanism (accomplishing 70% of the requirement); and 2 implies the basic and advanced (expanded) search mechanism (accomplishing 100% of the requirement).

Once all elementary criteria are agreed and data collected, we can obtain the quality preference for each attribute of a system or competitive systems (the fourth step of Web-site QEM). The global quality degree of satisfaction of all involved characteristics is obtained by logic aggregation of elementary preferences. In the fifth step, we use the Logic Scoring of Preference which compute the global site preference from elementary ones applying logic operators based on weighted power means [Dujmovic 96].

4. Concluding Remarks And Future Directions

Web developments are continuous and rapidly growing due to the wide acceptance of Web-based systems for very different audiences. However, this rises issues like how to design for quality and cost-effectiveness taking into account the satisfaction of different users' needs and behaviors, or how to assess, interpret outcomes, and, ultimately, improve the quality of Web artifacts, among other issues. One effective strategy to face these, is product (and process) modeling using prescriptive and/or descriptive approaches [Olsina 98b]. Process and product modeling potentially allows us, the understanding and communication; the evaluation and improvement; the control and forecasting.

In this direction, this work proposes a quantitative evaluation method to assess and compare the current Web-site quality regarding a user viewpoint. The primary goal was to classify, in a standard-compliant way, quality characteristics and attributes for general visitors. This activity (as part of the third process step), implies a hierarchical decomposition from the higher level of the tree –at the characteristic level-, to the lower level of the tree, the quantifiable attribute. Hence, the attribute is at the elementary metric level. This requirement decomposition framework is easy to understand, powerful, and flexible. It allows deletions, additions, and modification of its components. Moreover, we are arranging characteristics and sub-characteristics to be as useful for most Web-site domains as possible regarding specific users. (In fact, the highest level like Usability, Functionality, Reliability, etc. are thought to be domain-independent characteristics). Also, as previously said, the relative importance of characteristics varies depending on users and domains. Therefore, we have defined three views of quality: visitors view, developers view, and managers view. Thus, from the point of view of general visitors, artifacts characteristics such as Maintainability and Portability will not be taken into account; though, from the point of view of developers might not be excluded. On the other hand, managers not only will be concerned with quality but also with cost-effectiveness issues.

Besides, we have discussed quantitative evaluation criteria for some elementary attributes, and we have shown the main method activities. One strength of Web-site QEM resides in the modeling of great amount of attributes using the LSP approach. We can model simultaneity, replaceability, neutrality, symmetric and asymmetric attribute relationships using logical aggregation operators. At the end of the evaluation and comparison process, we obtain for each selected Web system a global indicator using the scale from 0 to 100%. Such cardinal rating will fall in three acceptability levels, namely: *unsatisfactory* (from 0 to 40%), *marginal* (from 40 to 60%), and *satisfactory* (from 60 to 100%). Ultimately, the rational utilization of our method should help reduce subjectivity in the process by providing a quantitative basis for quality assessment. Furthermore, it provides a powerful tool and concepts to understand and improve the quality of Web sites.

Finally, we have run a case study on typical, well-known museums [Olsina 99], and other on typical academic sites [Olsina et al 99]. Currently, we are running two evaluation projects in the arena of e-commerce. On the other hand, the Web-site QEM include a step for the quality metric validation, both theoretically and empirically. Ultimately, this research aim is strengthening the evaluation methodology.

5. References

[Dujmovic 96] Dujmovic, J.J., (1996), *A Method for Evaluation and Selection of Complex Hardware and Software Systems*, The 22nd International Conference for the Resource Management and Performance Evaluation of Enterprise Computing Systems. CMG 96 Proceedings, Vol. 1, 368-378.

[Fenton et al 97] Fenton, N.E.; Pfleeger, S.L., (1997), *Software Metrics: a Rigorous and Practical Approach*, 2nd Ed., PWS Publishing Company.

[Garzotto et al 97] Garzotto, F.; Mainetti, L.; Paolini, P., (1995), *Hypermedia Design, Analysis, and Evaluation Issues*, CACM 38,8 (Ago-95); 74-86.

[IEEE 99] IEEE Web Publishing Guide, http://www.ieee.org/web/developers/style/

[IEEE 92] IEEE Std 1061, (1992), *IEEE Standard for a Software Quality Metrics Methodology*

[ISO 91] ISO/IEC 9126, (1991) International Standard, *Information technology – Software product evaluation – Quality characteristics and guidelines for their use.*

[Lohse et al 98] Lohse, G.; Spiller, P., (1998), *Electronic Shopping*, CACM 41,7 (Jul-98); 81-86.

[Nielsen 99] Nielsen, Jakob; The Alertbox, http://www.useit.com/alertbox/

[Olsina 98a] Olsina, L, (1998), *Building a Web-based Information System applying the Hypermedia Flexible Process Modeling Strategy;* 1st International Workshop on Hypermedia Development, at ACM Hypertext 98, Pittsburgh, US, http://isc.ee.uts.edu.au/hypdev/.

[Olsina 98b] Olsina, L., (1998), *Toward Improvements in Hypermedia Process Modeling*, Symposium of Software Technology, 27 JAIIO, Bs As., 219-226.

[Olsina 99] Olsina, L., (1999), *Web-site Quantitative Evaluation and Comparison: a Case Study on Museums*, ICSE '99 Workshop on Software Engineering over the Internet http://sern.cpsc.ucalgary.ca/~maurer/ICSE99WS/ICSE99WS.html

[Olsina et al 99] Olsina, L., Godoy, D; Lafuente, G.J; Rossi, G.; (1999), *Quality Characteristics and Attributes for Academic Web Sites*, WWW8 Web Engineering'99 Workshop, Toronto, Canada http://budhi.uow.edu.au/web-engineering99/web_engineering.html

[Rosenfeld et al 98] Rosenfeld, L., Morville, P., (1998), *Information Architecture for the WWW*, O'Reilly.

[Rossi 96] Rossi, G., (1996), *Object-Oriented Methodology for Hypermedia Application Design*, Doctoral Thesis, PUC-Rio, Br.

[W3C 99] W3C, (1999), W3C Working Draft, WAI Accessibility Guidelines: Page Authoring, http://www.w3c.org/TR/WD-WAI-PAGEAUTH/

Academic Support for Web Course Development: A Successful Top-Down Strategy

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Abstract: The administration of the University of Central Florida has found a top-down formula that is successful at encouraging the faculty to design, develop, and deliver Web-based academic courses. This paper describes the history of the development of the program and reviews one faculty member's experiences in designing, developing, and delivering a Web-based graduate level course.

1. Growth of UCF

UCF has grown from an initial enrollment of just under 2,000 in 1968 to just under 30,000 during the 1998-1999 academic year. During recent times, a new academic building has been added almost every year, and parking garages are now taking the place of parking lots. Growth of the campus, the adjacent research park, and area business and industries have pushed the regional transportation infrastructures to the limits. As a result, the administration of the University of Central Florida has become very interested in nontraditional methods of course delivery, and travel-weary students have shown surprising support for some of the alternatives that have been offered.

UCF Student Profiles

Student Classification	Part-Time	Full-Time	Avg. Age
Freshman	347	4,782	18
Sophomore	1,092	3,428	22
Junior	1,701	3,691	24
Senior	3,993	5,209	27
Total Undergraduate	7,133	17,110	24
Beginning Graduate	2,481	1,002	32
Advanced Graduate	428	192	35
Total Graduate	2,909	1,194	32
Post-Baccalaureate	1,358	117	34
Total UCF	11,400	18,421	26

Figure 1: 1998-1999 UCF Student Profile

The statistics illustrated in Figure 1 show a significant part-time student body with average ages above what is commonly found in resident university settings. The higher than normal number of part-time students, and the higher than average ages of the students are typical of a modern metropolitan university. These are the students supporting the increasing demand for non-traditional course delivery strategies. Additional statistics can be accessed online at two locations:

University of Central Florida Public Relations (http://www.oir.ucf.edu/pubrel/facts/index.htm)
University of Central Florida Institutional Research and Planning Support (http://pegasus.cc.ucf.edu/~irps/)

2. UCF Budget Model

The budget at UCF is similar to the budgets at many universities. It has objective, formula based components and subjective "special initiative" components. Some portions are based upon historic funding models that are older than UCF itself. What follows is a simplified and not completely accurate discussion of one of the more controversial aspects of the funding model

Perhaps the most divisive component of the budget is a formula that determines the base level of funding for the individual colleges. It is tied to productivity as measured by student credit hours and produces an output of administrative, faculty, and staff positions that can either be filled with real people or left unfilled, releasing the salary dollars for other purposes. Figure 2 is a greatly simplified illustration of this issue. For the sake of simplification, a number of additional factors such as advising loads and off-campus course activities have been excluded, although they also enter into the determination of the final number of faculty lines per college. The real-world results are similar to the simplified illustration though; it is very possible for the same initial level of student productivity to produce twice the funds in one college compared to another.

College	Sample SCH	Productivity Factor	Faculty Lines	Line Salaries	Dollars Generated
A	10000	1283	7.79	$55,000.00	$428,682.77
B	10000	1300	7.69	$90,000.00	$692,307.69
C	10000	987	10.13	$53,000.00	$536,980.75
D	10000	819	12.21	$68,000.00	$830,280.83
E	10000	1250	8.00	$58,000.00	$464,000.00

Figure 2: Sample of formula-based funding inequities

It can reasonably be argued that historically, some colleges have had to pay much higher faculty salaries than others in order to attract equally qualified people. However, the model intentionally produces more faculty lines than are normally filled by the colleges. The funding from the unfilled lines is converted into operating funds, and this is where it is possible for colleges to end up with major differences. For example, it can be argued that productivity-based funds that are not used to fill faculty lines in a "have" college can be used to purchase almost twice as many computers as similar funds in a "have not" college.

To counter some of the apparent inequities that are created by the formula-based funding model, significant funds are held in reserve to be awarded as special projects, or "specials" as they are commonly called. Although specials are awarded to all colleges, there is little evidence that they balance the apparent inequities in funding.

3. Development of a Distributed Learning Plan

Although many administrators at UCF acknowledge that the base model of funding is not perfect, there is no consensus upon how to improve it. Any changes that improve funding to colleges that appear to be under-funded will naturally reduce the proportion of funding to the other colleges. It is almost certain that no dean will build popularity within his or her college by willingly giving funds to other colleges. It is in this financial environment that the need to expand our distributed learning initiatives arose. The solution was to take the needed funds "off the top" of the budget.

3.1 Center for Distributed Learning (http://distrib.ucf.edu/cdl/home.html)

By the summer of 1997 a decision was made to provide a new service to the colleges and faculty of UCF. The Center for Distributed Learning was created under the office of the Vice Provost of Academic Programs. Funding for the center is taken off the top of the University budget, and its resources were made available to all faculty. The Center coordinates all distributed learning activities, including delivery technologies such as videotape, interactive television, electronic mail, and web-based instruction for the distant learner as well as traditional on-campus courses delivered in part through electronic media. For this paper, we focus upon the course development and delivery that uses the World Wide Web in whole or in part.

To "kick start" the Center, funds were set aside for internal grants that were given to faculty through a competitive grant program. The funds were sufficient to supply faculty with a state of the art desktop or laptop computer, an adjunct to cover one course during the development semester, and a graduate assistant to help during the first time the course was taught during the next semester. The Center is now starting its third year, and it continues to fund at least 12 new course development projects each semester.

3.2 Course Development and Web Services (http://reach.ucf.edu/~coursdev/)

A second new office, Course Development and Web Services, was created under the Vice Provost of Information Technologies to provide direct faculty support in the design and development of new Web courses. This office, too, is funded off the top of the university budget. This office is available to all faculty, whether they have a course development grant or not, and whether they are working on their first or sixth Web-based course. A number of services are provided, including faculty training, assistance with course design, course coding, and trouble shooting. A faculty member can choose to design, develop, and code the course with a minimum of assistance, or the faculty member can supply the basic curricular content to the Course Development staff and let them do most of the work of getting the course online.

4. Growth and Current Operations (http://distrib.ucf.edu/dlucf/home.html)

There are two types of courses that are of particular interest when we discuss Web courses at the University of Central Florida. They are designated by specific section codes.

M Sections. Courses that contain an M in their section number have at least half of their content offered through the Web. They are structured in such a way that a single classroom time slot can be used to support the in-class time of two or more M courses by alternating the course meeting dates. This allows more efficient use of on campus classroom space

W Sections. Courses that contain a W in their section number are offered through the World Wide Web. They require only minimal visits to a campus. For example, the only visit might be for an in-person final exam.

The offices of the Center for Distributed Learning and Course Development and Web Services are just two years old now, so it is difficult to determine any clear patterns at this point. However, the Figure 3 summarizes the number of students who have taken courses that have significant Web components. Web courses are now offered by all five colleges. This represents a very solid argument for providing open access to campus-wide offices that are funded off the top of the university budget.

	Fall	Spring	Summer	**Total**	Fall	Spring	Summer	**Total**
	1997	1998	1998	**97 - 98**	1998	1999	1999	**98 - 99**
Students in "M" Sections	3700	2250	749	**6699**	5758	4293	1324	**11375**
Students in "W" Sections	392	691	667	**1750**	968	1407	1585	**3960**

Figure 3: Students enrolled in "M" and "W" course sections over the first two years

5. Web Courses from the Faculty Perspective

The paper up to this point has provided a background to the driving forces and current state of Web course development at the University of Central Florida. What follows are the experiences and opinions of this faculty member as he went through the processes of initial training, development, coding, and delivery of a Web course. It is said that trying to get faculty to do anything new will be futile unless three conditions are present: incentives, resources, and rewards.

5.1 Incentives

The perceived incentives are certain to vary from one faculty member to another. However, the UCF Web course development program has made it likely that many faculty will find some form of incentives. For many, the incentive of the grant – recognition, released time from teaching, graduate student assistance, and funding – serves as sufficient motivation to get going. My case is a bit different. I was on a sabbatical and did not need released time. I'm a full professor and don't really need much more recognition, and I have an adequate computer system at my desk. However, there were still incentives.

I teach courses in a graduate Instructional Technology program. In fact, a number of my current and former students are now employees of Course Development and Web Services. With a number of faculty around me getting involved in Web courses, I was starting to feel a bit outdated. It occurred to me that a sabbatical was the perfect time to get caught up.

I work a great deal with multimedia technologies, and I'm uncomfortable talking about technologies in my classes unless I've actually worked with them. I was being asked more and more questions about Web-based training by my industry and military students, and I was having trouble finding answers. What better way to speak with authority than to use your own Web course as an example?

5.2 Resources

The UCF Web course development program provides outstanding resources. In fact, first exposure to the number of resources can be overwhelming. As previously mentioned, a faculty member with an internal development grant gets an adjunct to cover a course to provide released time, funding for computer equipment, and graduate assistant support. Beyond that however, any faculty member has numerous resources available.

IDL 6543 (http://reach.ucf.edu/~idl6543/) is an intensive, almost formal course that is taught by the Course Development staff. Portions are lecture / discussion, laboratory, and Web-based. It is open to any faculty member, but it is required for those who are awarded the internal grants for Web course development. The course covers a wide range of topics relating to Web course attributes, course design, course coding, and implementation. Projects during IDL 6543 result in the actual development of significant portions of a Web course.

WebCT Academy (http://reach.ucf.edu/~webct411/) is a series of Course Development workshops that provide a range of experiences with WebCT (http://www.webct.com/webct/), the course development, delivery, and management tool used at UCF. The workshops range from introductory overviews of WebCT through intensive authoring and management tasks.

Pegasus Connections CDROM (http://reach.ucf.edu/~coursdev/cdrom) is a modern faculty and student resource that contains almost every document or link that you can imagine. It also contains basic Web course training for students and faculty, and it has a number of licensed programs and plug-ins that are commonly used with Web browsers. It is given to faculty who are teaching Web courses, and it is sold to students for a minimal $5.00 charge.

Finally, the Office of Course Development and Web Services supplies a wealth of resources in the form of talented people. There are instructional designers, graphic artists, course programmers, technical problem solvers, and others. Faculty who are new at developing Web courses are linked to a primary contact who serves as the facilitator throughout course design, development, and delivery.

5.3 Rewards

Standards have evolved over the last few years at UCF. While in the past there was a very clear "technology penalty" for working with or producing anything that was not ink on paper, that is not the case now. Successful innovation in course development and delivery is now viewed as an important component in the tenure and promotion processes at both the college and university levels. A successful implementation of a technology mediated course is often considered the equal of a refereed research journal article.

At the end of each course development cycle, the new courses are demonstrated at a luncheon ceremony. Deans, department chairs, and faculty attend, and faculty give short presentations that highlight key aspects of their courses. Deans and chairs have frequently commented that the presentations have really made them aware of the outstanding efforts that have gone into the course production activities.

6. EME 6062 – Course Design, Development and Delivery

The remainder of this paper provides documentation into the amount of time required to develop and deliver a Web course. Figure 4 provides a summary chart of the time spent on various tasks. I am a "typical" faculty member in most ways. I know my course content very well. I know how students react to various parts of my courses. I have a number of courses to teach. I advise students, and I work on many different types of committees. However, I am probably not a typical faculty member when it comes to technology-based course development. I teach the process of instructional design, and I teach computer-based authoring systems. I chose to do much of the Web course development on my own so that I could better understand what is involved.

EME 6062 Web Development and Delivery
Hours on Tasks

	Faculty Training	Course Development	Course Coding	Forums Email	Grading	Totals
Spring '99	68	75	75	43	45	306
Summer '99	4	2	2	*	*	*

* Incomplete data

Figure 4: Hours required to perform specific tasks in course development

6.1 Facutly Training - IDL 6543

This is the quasi-formal course for faculty who are developing Web-based content. It has lecture, lab, and online components. There are assigned activities, and products that must be turned in. During this course the faculty member learns to use the prescribed tools and techniques that are supported at UCF for Web course development and delivery. This was a very interesting course for me, in that I was a student of some of my former students. I found that they had no problem treating me as "one of the faculty," and I found that I was soon interacting with them as a peer.

Probably the most rewarding aspect of this course was the interaction with a variety of faculty from across the campus. While I knew technology very well, I quickly learned that some of the faculty from Arts and Science had far better ideas about successful communication and presentation strategies than I did. The "cross fertilization" of academic disciplines was most rewarding. The total time required to complete the course was approximately 72 hours, divided almost equally between lecture sessions, lab sessions, and online time. There were also a few minor training components relating to WebCT advanced features and course recycling that are included in this figure.

6.2 Instructional Design and Coding

I selected a graduate research literature course (http://reach.ucf.edu/~eme6062/) for development into a Web delivery format. To address accreditation issues, the course has two "in person" meetings. One is at the start of the course to meet the students and provide a basic course indoctrination, and the other is for an "in person" final exam. For students who are distant, the final exam can be proctored by a faculty member at a local university or community college. The Web section of the course is now finishing its second cycle. During the spring semester, 1999 the first Web section was offered concurrently with a traditional section and students were given their choice of taking either. There were 24 students in the Web section and a similar number in the traditional section. During summer session, enrollments are typically lower. Only the Web section of the course is being offered, and there are 16 students enrolled.

Probably the greatest surprise for me was the amount of "new" course material that was required in order for the traditional course to become a Web-based course. Although I had heard the warning a number of times, I was not initially prepared for the effort it took to create a Web course that provided experiences similar to the traditional course. Web course design is not simply a process of converting your course notes to electronic format! The time spent on course design was approximately 75 hours. However, the second time the Web course was taught, only 2 hours were required to correct some minor flaws.

Getting the course into the WebCT format was time consuming, but it was no different that learning a new authoring system. The content of the course is stored in HTML format. Although WebCT provides basic tools that convert text to HTML, I found in many cases it was faster and easier to edit directly in HTML code. Unless you are already familiar with authoring systems and HTML code, this is the one area that I would advise faculty to turn over to the technical programmers. Course coding took approximately 75 hours. However, with proper materials at hand, one of the course programmers probably could have completed the task in less than half the time. The second time the course was taught, only an additional 2 hours of coding were required to make some minor corrections, update some Web links, and reset the course for the new students.

6.3 Web Course Delivery

There are two face-to-face meetings with the students. The first is a course orientation at the beginning of the semester. This orientation covers general University procedures for Web courses, and specific procedures for this course. Since this course relies very heavily upon electronic library resources, there is an electronic library orientation. At the end of the course, there is a standard "in person" final exam. Student ID's are checked to confirm their identity, and they then take a comprehensive course final exam. The face-to-face components take a total of about 8 hours each time the course is taught.

The primary methods of communication with the students are through email, forums, and online interactive chat sessions. The total time spent during the first time the course was offered is 35 hours, with 3 of those being online chats. At this time, the second session of the course is not complete, but it appears that the "communication" time will be slightly lower. This is almost certainly due to the lower summer enrollment in the course. The level of communication time seems closely related to the number of students in the course.

6.4 Grading

This is a graduate research literature course, so the students produce quite a bit of literature. The first quiz is graded by WebCT because it is completely objective, but all remaining work requires some level of "hand" grading. By far the most time consuming is the process of grading the final projects, which are literature reviews or annotated bibliographies. Grading for the spring semester course took approximately 45 hours, but it is expected that this number will be lower for summer term due to the reduced enrollment.

7. Student Perceptions

Since this course has run through completion only one time so far, insufficient data have been collected to provide a clear picture of student attitudes and performance. From the information collected, students considered the course to be about the same amount of work as similar traditional graduate courses that they have completed. They had a few frustrations dealing with technical details of getting everything started, but once they were underway they liked being able to work at home on their own terms. The final grade distribution appears to be very similar to those of the traditional sections of this course.

Faculty and staff are conducting research regarding student attitudes and over-all effectiveness of our online courses. Much of this research can be viewed online at (http://reach.ucf.edu/~research/). In general, students like Web courses. They have had frustrations with slow connections to campus, but recent campus Internet connection improvements seem to have reduced those problems. Preliminary research is indicating that there do appear to be differences in attitudes among the students based upon personality and learning style measures.

8. Things to Improve Upon

Perhaps the greatest problem is the limited physical space that is available to the Course Development and Web Services office. The rapid growth in staffing has resulted in three or four employees working in what would normally be considered a single office. There is little room for people or equipment, and the ventilation system is not capable of handling the load. Efforts are underway to locate additional space.

Rapid growth has also created confusing logistics. While many faculty do build and revise their own Web courses now, there are barriers to the process. The Web server that delivers the courses is also the Web server upon which courses are developed. Testing and debugging courses and associated programs have been known to bring down the entire server – something that can be very frustrating to students in the middle of other courses. A separate server is needed for course development and debugging. This would make it possible to implement the server side of Web page development software, something that is not now permitted.

The Center for Distributed Learning and the office of Course Development and Web Services are both very new. They have been positioned into an otherwise very traditional academic structure. There are confusing overlaps and contradictions in the missions of the two new offices and several older offices, including Faculty Training and Development, Instructional Resources, and Computer Services. Additional efforts should go into more clearly defining the roles of these offices, and improving information flow and cooperation among them.

Developing a Science Inquiry-Based Web Site: The Science Junction

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Abstract: NC State University provided funds for a project called The Science Junction. The primary purpose of The Science Junction is to promote the "doing" of science by students of grades 4-12 through Web-based activities and resources. Other purposes of the site include assisting teachers and parents to locate good science learning resources, promoting communication among teachers for collaboration and for the development of a science teacher learning community, and assisting teachers in the learning of new technologies and the practicing of new methodologies. This paper describes the development of the activities included in the Science Junction, http://www.ncsu.edu/sciencejunction/

I. Introduction

In recent years, Internet connectivity in U.S. schools has advanced substantially as a result of increased attention from national policy making leaders and community leaders. The President's Educational Technology Initiative [Gore 1996] calls for classrooms to be connected to one another and to the outside world and for teachers to be ready to use and teach using technology. In just three years, the percentage of U.S. public schools with Internet access increased from 35 percent in fall 1994 to 78 percent in fall 1997 [Bare & Meek 1998]. More instructional classrooms are becoming connected to online telecommunications. Bare and Meek also reported that the percentage of schools with Internet access in five or more instructional rooms per school increased from 25 percent in 1996 to 43 percent in 1997. A 1997 report from the National Center of Education Statistics [Heavside, Riggins, & Farris 1997] indicated that 87 percent of the schools that lacked Internet capabilities reported planning to obtain Internet access by the year 2000. If these schools are able to acquire access, 95 percent of all American schools will have Internet access in the year 2000.

There has been a significant increase in the number of educators who use telecommunications networks, as well as growth in the number and quality of networked educational resources [Anderson & Harris 1997]. There are many common rationales for using advanced telecommunications to meet pedagogical goals. Frequently cited in current research are: Bringing real-world relevance into the classroom; helping students perceive knowledge as constructed rather than delivered from a book or teacher; providing students with an effective model for lifelong learning; strengthening social, communication, and critical thinking skills; meeting standards for inquiry-based learning; increasing the authenticity of the learning environment; changing the definition of the learning community to extend beyond classroom walls; finding role models for students; and promoting equity by providing all schools access to the same resources [Schrum & Berenfeld 1997; SRI International 1997].

Web-based networks use can help educators stay current with best practices in their field and help them to overcome problems such as teacher isolation. As with any profession, teachers need opportunities to expand their knowledge, keep pace with developments in their field, try out new innovative teaching methods, exchange ideas with peers and experts, and refine their skills. Network exchanges present a prime opportunity for collaboration among teachers [Merseth 1991]. Teachers with access to telecommunications networks can contact other educators to discuss issues relating to their teaching practice, developments in their field, and classroom experiences.

Text-dominated pages with few graphics and photographs characterized the advent of web page authoring. As the media has developed, more sophisticated techniques can be used to promote more interactivity. This includes the use of cgi, java programming, and various formats of video displays. The development of the Net Forum enables users to interact with other users using a Web-based format. The use of these cutting edge developments along with more advanced Web browsers allows creative authors to generate Interactive Web-based, hands-on science activities.

NC State University provided funds for a project called The Science Junction. The primary purpose of The Science Junction is to promote the "doing" of science by students of grades 4-12 through Web-based activities and resources. Other purposes of the site include assisting teachers and parents to locate good science learning resources, promoting communication among teachers for collaboration and for the development of a science teacher learning community, and assisting teachers in the learning of new technologies and the practicing of new methodologies.

2. Description of the Site

The Science Junction is indexed into six interconnected areas: The Data Depot, the Teacher Terminal, NC State Frontiers, Student Station, Communications Bridge, and Upgrade Route. Half of these areas are dedicated to student use and half for teacher and parent use. The Web site can be found at www.ncsu.edu/sciencejunction/.

2.1 The Data Depot

The Data Depot contains three sections: Collaborative Experiments, Collected Data, and Simulated Data. The focus of this area is to provide a means for students to post and share data they have collected on various experiments, to extract and evaluate other data previously posted, or to manipulate data generated by mathematical models. The Simulated Data section uses data generated from mathematical models. One good use of such generated data is shown in the Solar Eclipse Data Set '98. The data from the solar eclipse of February 26, 1998 was originally generated by NASA. This site includes the data in a modified data set which is useful for pattern finding and analysis. All data sets include a visualization of the data. The solar eclipse data allows the user to select two locations from where the eclipse was visible. The browser allows the user to view the eclipse at the two locations. By looking at various locations, times when the eclipse occurs, and the eclipsed part of the sun, students can discover relationships between location and the parameters of the viewed eclipse. Even though the students did not directly collect the data, they are able to sift through the information using scientific processes.

An example of an activity from Collaborative Experiments is Water What-Ifs. This site enables teachers to learn how to make water quality measurements and to provide a way for schools around the world to share their water quality data. Instructional modules and lesson plans can be downloaded from the site in copy-ready forms.

2.2 The Teacher Terminal

The Teacher Terminal area is a resource for science teachers, which includes IMSEnet and Science Lesson Plans. IMSEnet (Instructional Materials for Science Teachers network) is a large Web site which lists science Web sites that have been determined to be useful for science teachers. The Web sites are categorized by content areas and topics of interest to teachers. When a category is selected, annotations of various web sites are delivered to the user. This resource is a time saver for science teachers who do not have the time or the expertise to search and evaluate the expanding number of science related web sites.

The Lesson Plans section contains original lessons developed by science educators at NC State to promote inquiry activities in the science classroom and laboratory. One such lesson plan, Carolina Coastal Science, uses photographs to prompt students to reflect upon environmental science issues. Within this site resides a classroom simulation/debate called The Shell Island Dilemma. The scenario of the dilemma is that the Shell Island Resort is in danger of being destroyed by a migrating inlet. Mason's Inlet is moving south rapidly. The Shell Island Resort is currently situated in an Inlet Hazard Zone and is in dire straits. The objective is to investigate the issues concerning the fate of the Shell Island Resort and then to debate the future of this and other oceanfront structures threatened by coastal erosion. As students engage in the investigation, they must identify the social, political and scientific issues with which different stakeholders must deal. The students are placed into the role of one of the stakeholders. Web-based materials are provided for student research.

We have been exploring ways to use virtual reality in our science investigations. Examples of this can be found in this lesson plans area. "Which Way Is North?" is an activity that allows students to develop skills in understanding location by exploring a variety of unique geological formations using Quicktime Virtual Reality (QTVR) panoramas and topographic maps. "Dino Inquiry" allows you to explore a variety of dinosaur fossil bones from the Dinosaur National Monument quarry using panoramas and digital still imagery. "Geologic Explorations" allows you to explore a variety of unique geological formations through the use of QTVR.

2.3 NC State Frontiers

To promote the reading of cutting edge research in the sciences, we have included a section in the Science Junction that enables users to review the research done at NC State. This area serves as a pointer to departmental, research group, and individual researcher web pages at the university. These web pages are written in non-technical terms so middle school students should be able to understand the content.

2.4 The Student Station

The Student Station is a place for students to interact with science outside of a school environment. This area contains two sections: Game Room and Home Experiments. Again, the focus of this area is to promote the "doing" of science. The Game Room allows students to explore with science simulations, and Home Experiments is an area for sources of ideas for hands-on experiments that students can do at home.

The Game Room is a place where students can interact with computer games that teach concepts in the various sciences. For example, Space Trak is a game where the students must move a spaceship around a prescribed path by applying an impulse in a given direction. If the students move outside the path, the spaceship explodes. By interacting with this game, students learn aspects of Newton's first and second laws of motion. Through trial and error, or through analysis of mistakes, students realize that net forces in the opposite direction to motion will cause the spacecraft to slow down, which is required to successfully navigate the turns. Another simulation located in the Game Room is called REACT! The students control the collision of two molecules by changing the orientation and speed of the molecules before the collision. By exploring the simulation, students discover that for reactions to occur, the molecules must collide, collide with the appropriate amount of energy, and collide in proper orientation.

A new site being developed for the Student Station is the North Carolina EarthKam website. This site allows visitors to explore the NASA EarthKam project work being done by middle school students in North Carolina. This site also includes science simulations of concepts to be learned by students who are involved in the Science House Student Mission Operations Center (SMOC).

2.5 The Communications Bridge

The Communications Bridge is an area that allows science teachers to interact with one another using a variety of tools. The site is for both novice and veteran science teachers. The SciTeach Forum is a web forum where teachers can easily send messages and read what others have to say. Messages are sorted by topic headings, making it easy to find items of interest. North Carolina State University student teachers of science use this web forum extensively during their professional semester.

Science Teachers who are interested in collaboration projects can register in the "Join the Database" section. They may also search the database to see if there are any other teachers who have similar interests for collaborative experiments.

2.6 The Upgrade Route

Not all science teachers have the ability to attend professional workshops to learn new teaching methodologies and to practice using new technology tools due to the remoteness of their locations or to their hectic schedule. This area provides a mechanism for those teachers to learn about such topics. The Upgrade Route consists of two areas: Professional Development and Technology Skills. Professional Development provides resources to upgrade the teacher's knowledge of such topics as National Science Education Standards, gender equity, cooperative learning, and multicultural education. This area is textual in nature and provides little interactivity. Technology Skills provides information on how to use the latest instructional technology advances for science teaching. The Upgrade Route provides step-by-step worksheets, video, and instruction manuals for a variety of tools for the science classroom.

3. Conclusions

The SERVIT Group (Science Education Research on Visual Instructional Technology) at North Carolina State University has been brainstorming and developing activities for the Science Junction for the past two years. We are now in the evaluation phase of the project, testing to see what students are learning by exploring this interactive environment. It is our intent to increase the motivation for students to pursue science and science related careers, as well as to provide the environment for learning science concepts.

The presentation of the paper will include demonstrations of the activities developed for the Science Junction. Participants are invited to preview the site before attending the conference to provide input to the developers of the Science Junction.

4. References

[Anderson & Harris 1997] Anderson, S. E., & Harris, J. B. (1997). Factors associated with the amount of use and benefits obtained by users of a statewide educational telecomputing network. Educational Technology Research and Development, 45 (1), 19-50.

[Bare and Meek 1998] Bare, J., & Meek, A. (1998). Internet access in public schools. National Center for Education Statistics Report No. NCES 98-031. Washington, DC: U.S. Government Printing Office.

[Gore 1996] Gore, A. (1996). The President's Educational Technology Initiative. [Online]. Available: http://www.whitehouse.gov/WH/EOP/edtech/html/edtech_f.html

[Heavside, Riggins & Farris 1997] Heavside, S., Riggins, T. & Farris, E. (1997). Advanced telecommunications in U.S. public elementary and secondary schools. National Center for Education Statistics Report No. NCES 97-944, Washington, DC: U.S. Government Printing Office.

[Merseth 1991] Merseth, K. K. (1991). Supporting beginning teachers with computer networks. Journal of Teacher Education, 42, (2), 140-147.

[Schrum & Berenfeld 1997] Schrum, L., & Berenfeld, B. (1997). Teaching and learning in the information age: A guide to educational telecommunications. Boston: Allyn and Bacon.

[SRI International 1997] SRI International (1997). Technology and education reform. A Research Project Sponsored by the Office of Educational Research and Improvement , U.S. Department of Education. [Online]. Available: http://www.ed.gov/pubs/EdReformStudies/EdTech/.

Rule based matching technique of one-to-one marketing for personalized cyber shopping mall

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Abstract: This paper proposes an effective personalization method, especially on rule-based matching technique and feedback profiling systems. This technique is able to support various personalized content by using rule-based matching system : rule statement was designed to describe or present various personalization technique. Customer reflects personalized content to feedback system for adative customer profiling information. Rule-based matching of one-to-one marketing is extremely useful for the ever-growing number of personalized electronic commerce systems.

1. Introduction

The rapid growth of the World Wide Web(WWW) has made it possible for a large amount of information resources on the Internet to be accessed easily, but most web sites don't communicate with customers because they don't deliver the information customer actually want. Most of time it is because web sites present the same information that companies use in their catalogs. In light of these trends, companies creating web sites to supply their customers, employees, and business partners with products, services, and information must evaluate their web strategies to provide personally relevant content and create one-to-one relationships [Peppers and Rogers 1996] with their customers.

we are approaching this goal from two directions that are closely related to each other: rule based matching technique, and feed back profiling system for adaptive personalized services. Personalization technology helps the customer get useful information easily. On most personalized WWW pages, the selection of information is customized according to each customer's preference or interest. The personalized Internet merchant server that we have developed is one of the systems using automatic personalization and feedback system. It creates personalized shopping malls or catalogs for each customer on the fly using customer profile and purchase history, and customer action to evaluate the customer's expected interest in each web page.(The rule based matching engine and the template process engine used in this evaluation process were developed by our lab) The customer profile is created automatically and is automatically updated according to the customer's operations on the web pages. We planned to get the advantages of both personalization by developing a personalized rule based matching system and adaptive feedback profiling. That is, the information would be filtered using personalization technology and would then be delivered automatically using the push mechanism and template process. This paper gives a high-level explanation of what one-to-one relationships are and how they are achieved with personalization techniques. Personalization is the third stage of web evolution.(the first stage is static site and the second stage is dynamic site with database connectivity), also builds on dynamic web technology to deliver dynamically generated content. In addition, it provides the capability to present personally relevant content. Each customer gets a customized view of the web site. Personalization is the only way to create customer loyalty and generate repeat visits to cyber shopping malls.

2. Personalized shopping mall for One-to-One marketing

Today many businesses approach the new technique of electronic commerce by usually placing their product catalogs on the cyber shopping mall and combining them with an interactive order processing function to capture payment and process the order. To these businesses, selling their products via the cyber shopping mall is simply another business channel. This approach is not suitable, as it does not differentiate them from their competitors and fails to attract and sustain the attention of their target customers. Businesses that strive to be successful in selling their merchandise through the Internet will have to take advantage of its inherent strengths.

The sequential solution to solve the problem is that attract and sustain consumers by pushing personalized and customized services related with a sense of community relevant to them, and that engage consumers in personalized dialogue, learning more about their needs to better anticipate their future needs and requirements. The next procedure is that motivate consumers by providing personalized incentives (coupons, advertisements) for them to move from dialogue to action such as ordering a product or completing a survey ,that fulfill transactions by reliably and securely supporting the full process of electronic commerce from promotional pricing to secure payment handling and that manage the process by monitoring results and allowing dynamic changes to business rules and content to ensure the system is achieving business goals.[Cliff Allen 1998]

3. Rule-based matching technique

The merchant server classifies its customers in categories based on their purchase history, customer relation with shopping mall. It recommends new products and services based on your customer category. The server also shows the customer targeted incentives and advertisement based on the customer profile. This is called rule-based matching because business managers can define business rules to match content with customer. The rule-based matching system has client-server architecture. The client side has two program modules, rule maker and profile maker that make or operate rule statement and the customer profile. The server side has three program modules, rule based matching engine, template process module, and feedback profiling system, and it matches input rule and generate personalized templates. The client side is in charge of rule and profile generation and the server side is in charge of evaluation of the rule and generation of personalized services.

<table>
<tr><th></th><th></th><th>Return</th><th>condition function</th><th>Operator</th><th>Variable</th><th colspan="2">Conj</th></tr>
<tr><td rowspan="19">IF</td><td rowspan="19">!</td><td></td><td>Customer(profile name)</td><td rowspan="16">==
+
-
/
*
%
in
!=
<
<=
>
>=</td><td rowspan="16">numeric
string</td><td rowspan="16" colspan="2">and
or</td></tr>
<tr><td>date</td><td>BoughtDate(product)</td></tr>
<tr><td>int</td><td>BoughtCount(product)</td></tr>
<tr><td>double</td><td>BoughtAmount(product)</td></tr>
<tr><td>double</td><td>BoughtAmountSince(product, date)</td></tr>
<tr><td>int</td><td>BoughtCountSince(product, date)</td></tr>
<tr><td>int</td><td>BasketCount(product)</td></tr>
<tr><td>double</td><td>BasketAmount(product)</td></tr>
<tr><td>date</td><td>BoughtCatalogDate(catalog)</td></tr>
<tr><td>int</td><td>BoughtCatalogCount(catalog)</td></tr>
<tr><td>double</td><td>BoughtCatalogAmount(catalog)</td></tr>
<tr><td>double</td><td>BoughtCatalogAmountSince(catalog, date)</td></tr>
<tr><td>int</td><td>BoughtCatalogCountSince(catalog, date)</td></tr>
<tr><td>int</td><td>BasketCatalogCount(catalog)</td></tr>
<tr><td>double</td><td>BasketCatalogAmount(catalog)</td></tr>
<tr><td rowspan="3"></td><td>View(product), ViewCatalog(catalog)</td><td rowspan="3" colspan="4"></td></tr>
<tr><td>Buy(product), BuyCatalog(catalog)</td></tr>
<tr><td>Register()</td></tr>
<tr><th></th><th colspan="2">Action function</th><th>Target kind</th><th>Target</th><th colspan="2">Apply count</th><th>Apply filter</th></tr>
<tr><td rowspan="9">THEN</td><td colspan="2">Push</td><td rowspan="3">Catalog
Product
Adbanner</td><td rowspan="3">catalogno
productno
adbannero</td><td rowspan="3" colspan="2">Integer</td><td rowspan="3">times
anytime
notbought
tillbought</td></tr>
<tr><td colspan="2">PushInBasket</td></tr>
<tr><td colspan="2">Mail</td></tr>
<tr><td colspan="2">AddBasket</td><td>Product</td><td>productno</td><td colspan="3"></td></tr>
<tr><th>Action function</th><th>Discount Amount</th><th>Discount Method</th><th>Target kind</th><th>Target</th><th>Apply count</th><th>Apply filter</th></tr>
<tr><td rowspan="2">Discount</td><td rowspan="2">double</td><td rowspan="2">%
amount</td><td>Catalog
Product</td><td>Catalogno
Productno</td><td rowspan="2">integer</td><td rowspan="2">times
anytime
notbought
tillbought</td></tr>
<tr><td colspan="2">Basket</td></tr>
<tr><td rowspan="2">Customer(profilename)</td><td rowspan="2">=</td><td colspan="2">Customer(profilename)</td><td rowspan="2">+
-
*
%</td><td colspan="2">Customer(profilename)</td></tr>
<tr><td colspan="2">string, number</td><td colspan="2">string, number</td></tr>
</table>

Table 1. Syntax of rule statement.

Rule-based matching technology needs rule statement for evaluate customer's condition that enable to receive personalized services. Thus, we have designed syntax of rule statement like that shown [Table 1]. These rule syntax almost cover or describe the personalization technique (that is cross-selling, up-selling, target mailing, target discount, profile updating, coupon and advertisement) for one-to-one marketing on cyber shopping mall. It is easy for web developers to provide personalized services because rule maker at client side help us to make the

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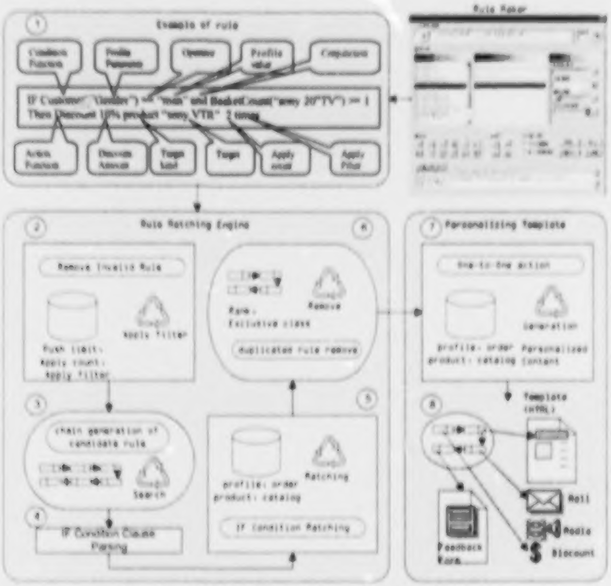
rule easily and conveniently. Rule statement is composed of "IF~THEN" mood syntax. The "IF" clause is composed of condition function for evaluation of the customer profile, purchase history, etc., operator for comparing with relevant value, actual comparison value, and conjunction for combination of various customer's condition. The "Then" clause is composed of action function for activating push process, target, target kind for object to push, apply filter for filtering candidate of rule, apply count for push count, discount amount, discount method for targeting discount. Defining the multiple conditions and one action does creating one rule for pushing personalized content with the rule maker. The rule will be generated by a relevant combination of rule component.



①
Example of rule
Condition Function
Profile Parameter
Operator
Profile value
Comparison
Action Function
Discount Amount
Target kind
Target
Apply count
Apply Filter
Rule Maker
②
Rule Matching Engine
⑥
Remove Invalid Rule
Push limit,
Apply count,
Apply filter
Apply filter
Rank,
Exclusive class
Remove
Duplicated rule remove
③
Chain generation of candidate rule
Search
④
IF Condition Clause Parsing
⑤
profile, order
product, catalog
Matching
IF Condition Matching
⑦
Personalizing Template
One-to-One action
Generation
profile, order
product, catalog
Personalized Content
⑧
Template (HTML)
Mail
Media
Discount
Feedback Form

Figure 1. Rule-based matching technique

[Fig 1]. shows the rule maker window at the client side, example of rule statement by rule maker and rule-based matching process. The "IF" condition clause can compose complex sentence, but "Then" clause can only simple sentence. If condition clause is true by matching process, action clause is processed. Of course, not every personalization rule is as simple as the example of rule. Complex personalization rules are supported with minor variations in this example. The Basic information of matching process is the purchase history of each customer that a set of words extracted from customer's order list . And the customer profile is a set of words and value. Then template tags are used to specify those rules. Template is pseudo HTML files to be composed of pure HTML tags and special tags. Template files is stored in database. The special tags represents the substitution value of actual database information that is catalog and product information and personalized contents. We explain rule-based matching technique by process flow shown in [Fig 1].

1. When customer navigated shopping mall, then rule matching process start. This rule in advance was generated by the rulemaker at client side, and rules maker store the rule to database at server side. Also basic profile information is generated by profile maker at client side, and profile maker store the profile in database at server side.
2. Fetch the rule from database. Then remove invalid rules using evaluation of apply filter and pick up the relevant rule.
3. Search matching rule using criterions of apply count. Then make a linked list for candidate rules.
4. Using yacc/lex parser, the "IF" condition clause is interpreted, and is divided into tokens.
5. Based of each token, relevant SQL statement was generated, and query is sent to database. Result of query is compared with token value, and output of matching process is true or false. Needed information of matching is customer profile, customer's purchase history, order information, catalog and product information of cyber shopping mall database.
6. Rule matching process can match duplicated rule. The push rule has the priority of rank, and this rank was interpreted. According to priority, remove the rule of low priority. The discount rule has exclusive class that is 0 or 1. If exclusive class is 0 , then unconditionally sum all discount's amount of matched rules. If exclusive class is 1, then select discount's amount of all.
7. Action process represents all personalized services: push(target-marketing, cross-selling, up-selling, target-advertisement), discount(shopping cart or basket discount, product discount, coupon), profile updating, and target-mail, etc. The function

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of these services included inside action process. Action processes start from interpreting "Then" clause, and then determine a kind of action function using results of interpretation. According to action type, content to be required will be fetched from database. For example, push services require catalog or product information, discount services requires customer's purchase history, and advertisement services require the customer profile.

8. Finally, template process generated a personalized content as HTML file, E-mail, or various media. For feedback profile updating, when type of action function in "Then" clause is "customer", template process generated a personalized HTML Form to get customer's response or preference. The merchant selects appropriate content that will appeal to customer based on rules stored in HTML template files. The template files also determine how content will be formatted, which means that the design of shopping mall can be separated from the content creation - making it easier to develop and maintain a personalized shopping mall.

4. Feedback profiling system

Rule-based matching technique must need the customer profile. The reason is that personalized services depend on customer profile as customer's interest, preferences, and taste. The purchase history of each customer is a set of words extracted from customer's order list. The customer profile is a set of words and value. Because of these characteristics of profile, basic information to be required to service will be acquired from customer by personalized HTML form type. Then additional profile updating, deleting, inserting is performed by feedback profiling system. Thus, immediately it can serve customer better.

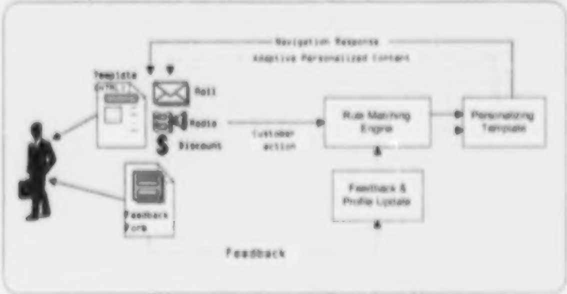

Figure 2. Adaptive feedback profiling system.

[Fig 2]. shows feedback profiling system that include feedback process. The feedback process builds and modifies a customer profile according to the customer's behaviors. When a customer does such operations as searching and viewing product on catalog, the system regards that the customer is interested in the catalog and modifies the customer profile or submit the HTML form related with the customer's preference so that it reflects the customer's interest more precisely. The dashed line flow is feedback process in [Fig 2]. The merchant server first sends a general content when customer entered into shopping mall as anonymous. If customer log in shopping mall as registered customer, it sends personalized content to be matched for customer. Without feedback process, profile operation was not occurred, and the enhanced one-to-one service will not be provided to the customer.

5. Conclusion

We developed the rule-based matching technique and feedback profiling for personalized cyber shopping mall by using information of the customer's profile, purchase history, the immediate customer' action, and we have applied the technique to personalized merchant server systems. There are various types of information on the cyber shopping mall. Some pages are updated very often, and some pages are updated only a few times a month or less. Conventional personalized services consider only the personal interest when filtering or sorting information, but our experience in a personalized web page service showed that the feedback system needed to be considered in order to help customers to get relevant information. The integration of the service supply needed to also be considered, especially in push-type services. Using the rule statement to represent the various one-to-one service enables separated services to be handled as one method of rule-based matching technique efficiently. By deploying the rule-based matching technique, web marketer will be capable of targeting single individuals and their unique needs. This will enable web marketers to extend the highest levels of personalized attention and service to all of their customers and to realize new opportunities to serve customers and generate profits.

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References

- Book references:
Don Peppers, Martha Rogers(1993). The One to One Future, currency/doubleday.
Don Peppers, Martha Rogers(1997).Enterprise One to One, currency/doubleday.
Cliff Allen, Deborah Kania(1998), Internet World Guide to One To One Web Marketing, wiley.
- Proceedings references:
Clive D. Wrigeley(1997), Design Criteria for electronic market servers, Electronic Markets, Vol.7-No.4-1997.
Ariel F. Luedi, (1997), Personalize or Perish, Electronic Markets, Vol.7-No.3-1997.
Hidekazu Sakagami, Tomonari Kamba(1998), Effective personalization of push-type systems visualizing information freshness, proceeding of WWW7 conference , 1998.
Bill Zoellick(1998), Collecting and Using Customer Data, Fastwater Rapids, Vol. 1.2, Aug 1998.
Adina Levin(1999), Sorting through Personalization and Targeting, Fastwater Rapids, Vol. 1.12 Jan 1999.
Lee Fife(1998), Customized Web Interactions – the next piece of the puzzle, Fastwater Rapids, Vol. 1.3 Sep 1998.

the electronic charrette:

Internet Tools for Participatory Planning

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www.lar.arch.vt.edu/program/CDT/ARCHTYPE.HTML

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the electronic charrette (Paul, 1996) is a short-term, interdisciplinary and collaborative online workshop that incorporates traditional communication tools and processes to generate real time planning and design data and a web site archive.

Introduction

As an electronic decision tool, the Internet is often championed by e-business and big government as the new 21st Century agora, or meeting place. But even with the rise and success of community networks like the Blacksburg (VA) Electronic Village, the Web as a community building and design place for community interaction lags behind the bucks and hype of the "where do you want to go today" set. At Virginia Tech and other places in the world, a focus on assisting people with their community visions both on and offline continues. MIT's Design Studio of the Future [1] and the UK's Online Planning Journal [2] are seeking ways to shift our focus from the high budget / high tech exclusive approach to a more equitable framework so that a citizen can educate, share and build vision into reality online—using asynchronous and synchronous tools and processes.

Bells and whistles do not a 21st Century village make!

As a test of our ability to work the Internet for the citizenry, a traditional - electronic decision making prototype, the electronic charrette (ec) is now under development at Virginia Tech. Our overall goal to strengthen grassroots community building and education through a smarter information technology tool kit for anyone interested in participatory planning and implementation.

The electronic charrette (ec) is both an extension and a hybrid of the traditional landscape or urban design charrette that became popular with groups like the AIA / UDAT [3] and the Minnesota Design Team [4] back in the 1970's and 80's. The ec combines online and traditional community building and design tools for the Internet. The electronic charrette was created and tested twice at the Urban and Regional Studies Institute at the University of Minnesota – Mankato [5] in 1996-97.

The third ec test event ran from October 5th – November 20th 1998 at Virginia Tech and incorporated a series of archived forums (i.e., bulletin board), e-mail and a live, one-to-one design event. While this ec test was modeling a community participation and design process, it became clear early on that the planners and computer scientists who volunteered to participate were not tied to any real issues. Clearly their overall involvement was deemed to be less than realistic than had they been stakeholders in a real issue –pushed community process. The test was a test of the ec process and tools; it was not about using these tools for a real community problem such as a pocket park or a strategic planning report.

This paper concludes with a brief discussion of the ec model can be deployed in additional ways.

Identifying participatory planning & design theory

While the ec technologies and process are still undergoing testing, companion investigation is moving parallel into identifying key participatory planning & design theories from academia. On the planning side, John Friedmann pointed out in 1973 that "the growing technocracy of our society demands a decision-making method based on mutual learning. It is necessary to join scientific and technical intelligence with personal knowledge at the critical points of social intervention in order to avoid decision-making at the exclusive hands of the technocrat. **Transactive Planning** (TP), he maintains, is the most appropriate method for achieving this linkage." [6] Current research targets include: communication pathways between planner and citizenry; the context of social and physical landscape; and public participation processes

Two theories from Computer Science research also play a guiding role in this research. The first, **Participatory Design** (PD), gained prominence in the late 1970's when several Scandinavian countries introduced legislation requiring organizations to involve employees in decisions affecting their future conditions of work. PD is a philosophy, which encompasses the system lifecycle, incorporating the user not only as an experimental subject but also as a key member of the actual design team. Users are viewed as active collaborators in the design process rather than just 'passengers' whose involvement is defined by the system's developers. Tools and Techniques are similar to traditional (non-mediated) charrettes and can include: Storyboarding; pencil and paper exercises; workshops; and brainstorming session(s). Current research targets include competition, participation, corporate control, membership, and product lifecycle [7]

A second interrelated theory from computer science is **Computer Supported Collaborative Work** (CSCW). This research is machine-dependent and includes computer-based systems that support groups of people engaged in a common task that provides an interface to a shared environment. Coordination in CSCW is a key principle– that is, how actors can work together harmoniously. Current research targets include user activeness, openness, awareness, control, and conflict [8]

Is a new (hybrid) theory possible? It could be promising to propose and test a participatory planning and design theory that incorporates the traditional planning and design charrette with its Internet-process of the ec.

Project Goals:

The goals for the electronic charrette test #3 were follows:

1. Test concurrent use of real-time communication tools that include shareware.
2. Test and suggest possible extensions of the ec process model for other disciplines.
3. Better understand how the traditional process works online. How can we combine the two?

The process

Over a period of approximately six weeks, 5-6 participants used the ec participation guide (pdf - online) and web site instructions to test and critique the ec process model (described previously). Communication was channeled through e-mail, regular phone, fax, web sites, the ec forum and archive, and the ec mail archive. The live group collaboration event was later changed to a one-to-one live collaboration for simplicity and convenience. The process ended with a fully archived project web site and an evaluation. Please see the *ec news link* on the site for the accumulated data from the test.

Test #3 participants:

Anne Giffen, Comprehensive Planner - Town of Blacksburg, Virginia.
Shiv Pal Singh, Computer Science M.S. Student - Virginia Tech.
Edward Davis, Planner - Montgomery County, Virginia.
Supawadee Ingsriwang, Computer Science M.S. Student - Virginia Tech.
John Paul Foulger, EDP Student - Virginia Tech
Selden Richardson, Architectural Archivist - Library of Virginia.

The tools

Both synchronous and asynchronous communications were employed during the ec test #3. They are listed below:

- **project web sites** – two Mac servers were used for the test: one for the main pages and a second machine for the ec forum tool.

- **ec participation guide** – published as an Adobe pdf document, this includes all of the beginning web material and technical data to help the participants install the required software and to participate in the event.

- **pre-test survey** – placed and returned in e-mail, the survey attempted to lay a baseline for the subsequent discussions and evaluation.

- **ec forum** – an archived bulletin board tool that facilitated discussions on three (3) topics during the test.

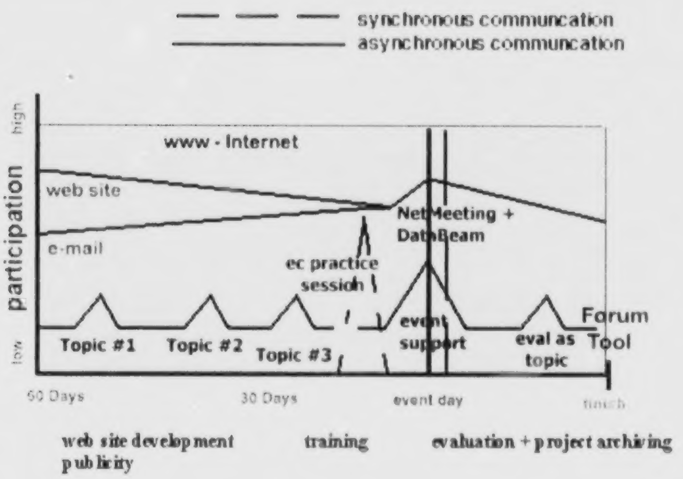
- **Jackson Ward Data Archive** – A database with multiple image and text formats was designed and deployed for the test that required plug-ins. This site was the "community" or issue set for the test. It included a panoramic image (VR), a gallery tour, an aerial photo, original building plans, and text documents concerning the historic Jackson Wad Armory in Richmond, VA.

- **DataBeam + NetMeeting** – shareware collaboration software for the live collaboration work. DataBeam supported the test. NetMeeting was used as a chat tool and DataBeam provided an enhanced whiteboard tool and workbook system for organizing and saving a document series.

- **ec mail archive** – the storage vehicle for miscellaneous communication during the test.

- **project archive and evaluation** – since the process was documented and archived at each stage, the test is considered "self-documenting." See the *ec news* site for event data. [9]

- **The ec process model** (see below) - while some would argue that the process model is a "timeline", it is clearly more than a time based "scheduler." A series of distinct charrette events are coordinated that include face-to-face sessions, various electronic communication channels , real-time design events and a project archive. Because specific total times for each ec project will vary, the ec process model is flexible by design.


synchronous communication
asynchronous communication
participation
high
low
www - Internet
web site
e-mail
NetMeeting + DataBeam
ec practice session
event support
Forum Tool
eval as topic
Topic #1
Topic #2
Topic #3
60 Days
30 Days
event day
finish
web site development
publicity
training
evaluation + project archiving

electronic charrette process model

wmpaul

test results from ec test #3:

summary data from the pre-test survey and event

Tool, Stage or Process:	Pre-Event Survey Responses:	Feedback from Overall Event:
1. **project web site:**	- expectations of participants unclear - index not needed - scrolling too much! - hit counter needed for sub-links	- ec model graphic is too small - site is easy to navigate - model needs to be image map / more explanation - more generalized?
2. **pre-test survey:**	(n/a)	- easy to use as an e-mail tool - design(s) for different user levels? - paper / fax option also desired
3. **ec forum tool:**	- easy to use - somewhat helpful for guided dialogue - good for introductions and instructions	
i. **pre-forum session** ("getting ready")	(n/a)	- useful for distance collaboration - good for archiving discussion/data - need more than one forum at a time - thread each participant and topic for record - good: responses are time / location independent
ii. **Data Archive** forum	- helpful site - usefulness of data based on each user's background and professional tract	- needs to be topic driven - download restrictions at VT-CS lab! for plug-ins - broad and inclusive data set - panoramic is Java-based and requires Java browser - need for more technical support: installation - how to fully realize "fabric" of building / site? - base level planning data needed (i.e.- zoning map)

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		- building plans are extremely important - create a hard copy version of the Data Archive - create linked floor plans for photo gallery tour - more aerials; less writing on the web site image - dead link to MSNBC piece on JW Armory
iii. ec participation guide forum	- somewhat helpful - more needed on overall ec process and goals - good as a broad explanation of event	- more tech help for practice session - more tech help: installation of plug-ins - glossary not used much – eliminate it? - good to print it as a companion to online site - add more screen shots of DataBeam + NetMeeting - create a web version of the guide - create "splashier graphics"
4. DataBeam + NetMeeting Tools:	(n/a)	- good combination for ec - need to test with more than two participants - use with audio + video for next test - decision to work one-to-one right move - more training and support needed for two tools - tip: practice with (MS) Paint program - prior knowledge / input on images selected - an integrated tool is needed to streamline process - collaboration moderator needed - chat helped to enlarge / extend collaboration context - use telephone when technical trouble hits - message to "take your time" - welcomed feedback - some were quick to take-off and try additional tasks - data bank needs to be designed for a "real problem" (i.e.- the test archive were not "reality centered!") - need a mouse to use these two tools! - overall, graphic design tools are good
5. ec mail archive:	(n/a)	- good tool for archiving secondary communication - source of outside event happenings and context - more useful to researcher than to participants
6. project archive and evaluation:	(n/a)	- project archive is the sum total of the completed ec event site; see ec news site for data from participant interaction. - this evaluation is designed to be published as a stand alone document (summary)

conclusions and future considerations

The electronic charrette process will undergo more tests with different problem types and participants in the coming months as new interactive tools and variations of the process model are tested. It is worth restating that this collaborative vision is more about proactive user training and less so on high-end software design. Additional corporate support, like DataBeam's contribution, will be sought! Overall, test #3 was successful in training and testing concurrent, real-time communication tools including shareware. By designing a variety of formats for the same information, participants had a choice in their preparation and could read the results of their interactions in the ec forum or through in the archives. The ec participation guide, while filled with useful information, and designed to be a hard copy tool, was both too complex and too little data for some members. More research is needed here. Finally, while member training was largely self-driven, more face-to-face / group sessions are required to support the ec process. In the future participants can use DataBeam workbooks / images off-line and better prepare for real-time collaborations. Audio and video should be incorporated in the next test to evaluate how participants respond to these added technologies.

extending ec process model:

It is possible to look toward future variations of the ec process model for other disciplines. If needed, times for each stage of the process are flexible. The ec process model is a time-flexible tool and can be adjusted with participant input at any time during the event. Instructions and other plans or images can be delivered on demand. Possible uses include:

- distant learning courses
- emergency project web sites
- just in time training
- software design (iteration)
- cyber-medicine

The author was project manager / designer for the summer 98' Jackson Ward Electronic Community Project (JWEC. [10] While the JWEC project utilized many of the test #3 tools and web design standards, it suffered from a lack of an online participant pool and from a proprietary-bent client who placed profit over assistance to the larger community. If the ec process model is to take on other disciplines and wider use, it is just these lessons from Jackson Ward that will need to be addressed.

Sources:

[1] MIT's Design Studio of the Future < http://alberti.mit.edu/dsof/index.html >
[2] Online Planning Journal (UK) < http://www.casa.ucl.ac.uk/planning/olp.htm >
[3] AIA / UDAT < http://www.ci.tacoma.wa.us/pds/planning/RUDAT.htm#Task >
[4] Minnesota Design Team < http://www.minnesotadesignteam.org/ >
[5] Regional Studies Institute at the University of Minnesota – Mankato:
ec I and ec II - < http://krypton.mankato.msus.edu/~tony/charrette/welcome.html >
[6] A Participatory Approach to Urban Planning. E.M. Burke. 1979. p. 296.
[7] "Participatory Design: Taking People Seriously", Imran Ahmad. See: <members.xoom.com/imranahmad/pd.htm>.
[8] "Survey Report of CSCW". See: <arirang.snu.ac.kr/~leeko/CSCW/Survey/survey.html>
[9] *ec news* site for event data < http://www.lar.arch.vt.edu/program/CDT/ECNEWS2.HTML >
[10] Jackson Ward Electronic Community Project (JWEC) <www.lar.arch.vt.edu/program/JWEC/MAIN.HTML>

Secure Virtual Library

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Abstract

In this article we will approach the topic of security in Web Servers,specifying the different applicable methods and its corresponding obtained levels of security. Besides a generic description, the information is extendedwith a real example of a Virtual Library for a better understanding of the concepts. The system has been developed in the Department of Languages and Computer Systems of the University of Vigo. Our purpose was to find a simple way to join two technologies: Web servers and database managers, and apply that to an easy-to-use school library service, both for students and library staff, while, at the same time, strengtheningthe concept of security, so that foreign people cant manipulate the stored information.

Keywords

Secure Web Servers, SSL, databases.

1 Introduction

Day after day, the most modern and well-known system of world communication, is not only monopolizing those fields for which it was considered good, but even changing the typical customs in human life, slowly relegating them to a completely virtual system.

Internet, the great net of nets, has not only suffered the biggest expansion ever in telematic nets, but it has also succeeded in taking advantage of the large technological base over which it was created, and in fulfilling thehigh-priority objective in any society: communication. The communication, together with the advantages that telematic services provide, allows us to offer the final user something that few people dare to reject: comfort. The big problem is that, along with this global communication, there appear newdangers related with the privacy of the information that circulates through the net, in our particular case, the one exchanged between clients and web servers.All this, and the hope of making clearer the concepts of security in web servers, and to eliminate part of the existent fear among the users when it comes to information running through Internet, is what has taken us to write this article and to develop a Virtual Library, together with the hope of being useful for the current scientific and educational society.

2 Description of the system

The system is based on a Web server that implements a series of security levels that are not available by default. The server, apart from controlling the graphic interface that is presented to clients, has the task of interacting with the database.

Security levels are added as server modules or as web page implementations. For the client-server connection, the http protocol is used, over the service offered by the SSL specification (secure sockets layer), using the POST and GET methods for sending information, which means that clients send character strings with the data to the server. The server receives these data and interacts with the database through sockets (tcp).

We have used as server a PC with Linux as operating system, specifically Debian 1.3.1. This server runs version 1.3.4. of the Apache Web Server, with patches for securetransactions, and the database engine PostgreSQL 6.3.2. Both the operating system, the web server, and the database manager are free-distributed. As for the development languages, we used html and PHP for the creation of dynamic pages.

3 Public and Private key

There exist two main ways to send encrypted data and their later processing. Those known as algorithms of private key, or symmetrical encrypting, use only one key that must be known by the two entities that communicate. When applied to Web servers, a big problem arises: the high number of users, that implies the same number of keys.This problem is solved with the algorithms of public key or asymmetric encrypting. Each user has two keys, a public and a private one, the former available at the so-called public-key servers, while the later is only known by him. These two keys are inverse, which means that what one encrypts the other one unencrypts, and viceversa.

When an user wants to send something to another one, he sends the information encrypted with the later's public key (known by all). Only someone who knows the private key can unencrypt the information, and the only one who does is the destination user.This method is very useful for the generation of so-called digital signatures that make possible to certify the authenticity of a message. An user, to certify that he is the source of a message and before he encrypts it with the public key of the receiving user, encrypts it (or at least a part) with his private key. Then he does it again with the public key of the destination user, whounencrypts the message with his private key, which results in an encrypted part, that he unencrypts with the public key of the former user. If the proccess is successful, two goals have been completed: nobody has been able to obtain the information since he should know the private key of the destination user, and he makes sure that the information has been sent by the source user, since nobody else can encryt the signature with his private key.

4 Apache+SSL

SSL (Secure Sockets Layer) is a propietary specification of Netscape, made public-domain for the definition of secure channels over TCP, Internet's point to point protocol. Its former goal was the establishing of secure connections to Web Servers, to send credit card numbers or access passwords, placing the HTTP protocol over the SSL [Fig. 1].

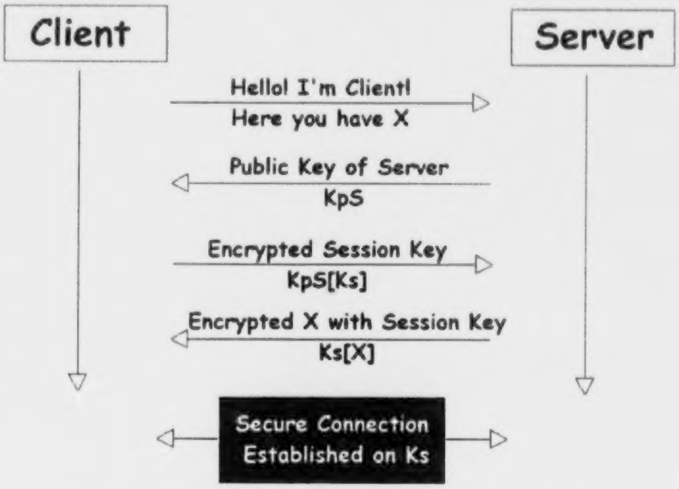

Figure 1. Description of the Secure Sockets Layer Protocol

When a client wants to begin a secure connection, it sends a message to the server along with a random number (a challenge). The server responds with its public key credited by a certification authority. Next, the client generates a key denominated session key (symmetrical) and sends it to the server encrypted with its public key. Now the server proves that it knows the private key associated to the public one by returning the challenge, encrypted with the session key that it would not have been able to obtain otherwise. Starting from this moment, a secure connection has been established, using the session key for the encrypting.To implement this, a Web server that allows secure transactions is needed. In the example, we have used a patch for the Apache server that is known as apache+ssl. This patch modifies the source code of the Apache so that, if the SSLeay function library is installed in the system, transforms the Apache into a secure server or secure transaction server. A client that wants to connect to a secure server just substitutes the protocol http:// for https:// in the url.

We can have different parts of the web with secure transactions or not in a single system running a web server, which makes sense as every encrypting operation slows down the system. Depending on the information to be encrypted, the slowing down effect may be worth or not. Secure servers prevent the stealing of access passwords or credit card numbers, through the use of sniffers.

5. PHP Language

What is PHP?. PHP[8] is a tool that lets you create dynamic web pages. PHP-enabled web pages are treated just like regular HTML pages and you can create and edit them the same way you normally create regular HTML pages. (PHP Page www.php.net) .PHP is a language specially focused in text file processing and access to databases.

It is a scripting language that the very web server can process if it is installed as a module or, otherwise, it can use an interpreter and run it through the CGI gateway[1]. It features a great simplicity in the processing of form variables and in accessing databases, providing functions for diverse database managers: Oracle, Informix, PostgreSQL[2][3][4][5][6][7], ODBC interface,... It works in the following way: when the client requests the server to send a pagewith the .php3 extension, the server preprocesses the file, executing the different commands as it finds them.

6. Security levels.

All UNIX systems have been designed with net-connectivity in mind, and thus they include many security tools[8]. We have used and taken advantage of several of these tools in our model, while we had to implement others.We can distinguish several levels:

- User Authentication.
- Ip Authentication.
- Access to certain directories.
- Access to the database.

6.1. User Authentication.

One of the essential ways to control a system's security is knowledge of who is using it, because with this information one can make a registration of use and carried out actions, grant a series of privileges or other, etc. The degree of securityprovided by authentication when accessing a webpage is totally similar to the one that an operating system offers.This level is implemented at the first connection to the server. When connecting to the library server through a web client, a dialog window pops requesting a login and a password.

6.2. Ip Authentication.

This level of security is completely transparent to the user. Access is restricted to a subset of ip addresses, for example, those within a Department, an University, etc. At this level of security, the system will have to deal with ip spoofing or ip falsification attacks.

6.3. Access to certain directories.

Built within the own server there is an authentication module for users or groups, and for accesses, reading and/or execution. We can include in these directories all those files that we want to protect. This level forces the client to provide a user's name and password that will grant him a certain access level. Once successful, the server no longer requests again. The authentication can be basic, challenge/answer-like as in NT, and even encrypting as in Kerberos.To implement this level, we have to deal with the access control files of the web server.

We can work with the access.conf file, from where we can control the access to any directory, but with the disadvantage that if it is modified, we must stop and run the server again, for it to update the modifications. On the other hand, we can use a file, usually denominated .htaccess that, placed in each directory, it allows us to set the same specifications as access.conf, but without having to stop and execute again the server when they are modified, as the server reads them everytime it accesses the directory. It is very used in Web servers where you want each user to be able to control the access to his web directories without having to warn the administrator. You can specify the annulment of the guidelines specified in this file or make those in .htaccess prevail on the ones indicated by the administrator in the access.conf.

6.4. Access to the database.

In principle, every access to the database uses the privileges given to the user nobody. If necessary, you could include in this level of security the own database manager, but we should not forget that one of the most important factors in the development of this project is comfort for users.

7 Other dangers

Another important problem that Web Servers have to deal with are the attacks that try to block it (Deny Of Service) like nukes, teardrop, ping flood, etc. To avoid all this we recommend to have the last stable version of the LINUX kernel installed, as well as to often revise the security lists to know new bugs in browsers or servers as soon as possible.Many are the elements needed for a system of this type to work correctly. All of them, hardware, software and the telematic net supporting it, bring about a higher degree of complexity in the system, due to the strong relationship that must exist among them.

This system has been designed to be used in TCP-IP, client-server communication nets, taking advantage of World Wide Web services[8]. All kind of nets are suitable: LANs (Local Área Networks), as far as they incorporate tcp/ip; any Extranets and Intranets; and, of course, its main application environment for which it has been developed, Internet.

Any WEB browser will do as client, since the application is based on the http service and it is the server that supplies the requested information in html format through the net. But as server, we need a system connected to the net, so that it can answer the incoming requests, be it a computer linked to a local net or a system in an ISP (Internet Service Provider). Maybe the most important thing to stand out is the absolute transparency to the user with regard to security levels, because we have sought to obtain a secure but at the same time usable system, always looking for a balance between both parts.

8. Conclusions and future

As implementation example of that explained in the article a virtual library has been developed for an university center, in the one that besides consultation of the existent titles in the database is allowed the reservation and on-line consultation of some of them. For the reservations and to restrict the access levels to certain areas (administration area, internal documents to the university community) the protection methods explained in the article have been used, from the encriptation of the communications to some administration protocols, generation and exchanges of keys of superior level.

As hardware server a Pentium 200 has been used with 64 Mb and hard disk of 4Gb, maybe some enlargeable characteristics in future versions if the access statistics and the size of the database require it.

The results have been very good and it has been proved that the use of a hardware not too high it is replaced with the use of an operating system one that takes advantage of the maximum the resources of the machine helped of a DBMS completely integrated with the native file system , in the way that they can share authentication.

The obtained knowledge have been quite important, apart from allowing the establishment of other previous ones. From the process of the design of the system, selection of the data to store and the design of the database, operating system and platform hardware, it has allowed us to fix some ideas that will allow us in a future to make much more complicated developments, never forgetting that the user's comfort is one of the most decisive factors when allowing the expansion and use of a system.

The resulting final system fulfills the requirements with which it was outlined, so that we have a product that is comfortable for users while, at the same time, it features good access security. However, during the development, we have found some important elements outlined by library professionals we have worked with and who have advised us. These points are relevant not from the technological point of view but from the perspective of the final user. Some of the points that should be revised are: Modification of the current system database so that it follows the MARC formatstandards.Improvement of the user interface to make it more friendly to final users, making it slightly different from classic designs in this kind of systems.Inclusion of new presentation formats for the information of the elements stored in the database, such as images of the covers of the books and sound files with descriptions of the publications.

9. References

[1] Documentation of cgihtml-1. 69 library.

[2] PostgreSQL Tutorial. Covering v6. 3 general for rereads you by The PostgreSQL Development Team. Edited by Thomas Lockhart. Last updated 1998-02-23.

[3] PostgreSQL User's Guide. Covering v6. 3 general for rereads you by The PostgreSQL Development Team. Edited by Thomas Lockhart. Last updated 1998-02-23.

[4] PostgreSQL Tutorial. Covering v6. 3 general for rereads you by The PostgreSQL Development Team. Edited and Thomas Lockhart. Last updated 1998-02-23.

[5] PostgreSQL Administrator's Guide. Covering v6. 3 general for rereads you by The PostgreSQL Development Team. Edited by Thomas Lockhart. Last updated 1998-02-23.

[6] PostgreSQL Programer's Guide. Covering v6. 3 general for rereads you by The PostgreSQL Development Team. Edited by Thomas Lockhart. Last updated 1998-02-23.

[7] The Postgres95 User Manual. Version 1. 0 (September 5, 1995). Andrew Yu and Jolly Chen (with the POSTGRES Group). Computer Science Div. , Dept. of EECS. University of California at Berkeley.

[8] Web Publishing Unleashed. Willian Robert Stanek. Sams.net Publishing. ISBN: 1-57521-051-7.

Collaborative Development and Joint Delivery of Telematics Based Courses Across Europe

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Abstract: This paper discusses the approach and achievements of T3 (Telematics for Teacher Training), a European project in the field of online teacher training, from the point of view of the Italian partner. The courses developed during the project are used to exemplify and discuss the pros and cons of the various design choices. The project developments support the conclusion that the European dimension has greatly contributed in two directions: towards the practical aim of setting up a network of institutions that collaborated and will continue to collaborate in the delivery of teacher training; and towards the methodological objective of striking a balance between different culturally and nationally biased teacher training approaches.

1. Introduction

This paper examines a project called T3[1] (Telematics for Teacher Training) funded by the European Commission within the Fourth Framework Programme, and in particular the "Telematics Applications - Education and Training" sector. T3 lasted three years (from January 1996 to December 1998) and was carried out by a consortium of universities and research institutions across eight European countries; it also had the support of a number of private companies such as national telecommunication providers and hardware and software producers. The T3 partners "researched and developed the infusion of telematics applications into courses, such that good practice with telematics was modelled in teacher training" [Davis & Prosser 1999]. Over 5,500 teachers and others were trained in Great Britain, The Netherlands, France, Portugal, Finland, Belgium, Ireland and Italy. The most tangible results that T3 produced are online courses dealing with languages, technology, environmental education, mathematics, and educational use of ICT (most of which have become on-going courses offered by some of the institutions involved) as well as a number of web-based resources for teachers, teacher trainers and librarians.

Rather than providing a detailed description of the project and its activities, which can be found in several documents and publications (complete list at *http://telematics.ex.ac.uk/T3/deliver.htm*), this paper looks at T3 from the point of view of one of the partners involved, namely the Institute for Educational Technology of the Italian National Research Council (ITD/CNR). It describes ITD's role in the project, and provides an insight into how the project developed and how, in the author's opinion, the complex process of mediation between the very different approaches taken by the various institutions involved lead to progress in the teacher training approaches and to awareness of the advantages and drawbacks of running Europe wide teacher training initiatives.

2. Getting Started with T3

In late 1995, ITD/CNR was invited by Exeter University in Great Britain to join the T3 consortium in the development and testing of teacher training courses, resources and services based on computer networking. ITD/CNR was not asked to manage a specific initiative within the project but to test training courses developed by other project partners (In EC parlance, the group of institutions proposing a project is generally referred to as a 'consortium' while its members are called 'partners').

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[1] Website at http://telematics.ex.ac.uk/T3/

Although this was an unusual role for ITD and presumably a rather passive one, we nevertheless accepted the proposal. Our acceptance was, so to speak, sight unseen, in that the courses to test had not yet been planned and their characteristics were to a large extent still unknown even to their designers. What was known at the time was the consortium's composition and partners' responsibilities: Exeter University was in charge of managing the project and responsible for the training courses addressed to mathematics teachers, Dublin University (Ireland) for those addressed to science teachers, Utrecht University (the Netherlands) for those addressed to language teachers and Oulu University (Finland) for those addressed to technical education teachers. A number of inter-disciplinary initiatives were also planned, including courses for teacher trainers (Exeter), courses for primary school teachers (Minho University in Portugal) and others for library managers (Exeter). The reason for addressing librarians too lies in their being in close contact with teachers and student teachers, and therefore being in a position to contribute directly to teachers' professional development by illustrating and demonstrating the phenomenal potential of communication technologies for retrieving reference material and consulting databases and/or virtual libraries.

As it stood, the project reflected situations within the various partner countries, some of which contrast sharply with the Italian context. So, working on a project of this kind also involves making an effort to overcome, or even make the most of, cultural and organisational differences which would otherwise undermine the development of fruitful collaboration between partners. For example, in many European countries teacher training means pre-service training, i.e. graduate or post-graduate specialisation courses which are a prerequisite for embarking on a teaching career. Based on the assumption that knowing a discipline does not mean being able to teach it, these courses offer future teachers specific training in the pedagogy of the discipline and also cover the study and field testing of high-potential new technologies in the teaching of the various subjects. The institutions offering this kind of training often have specialist libraries with staff that support and guide students.

By contrast, teacher training in Italy almost exclusively takes place on the job (though things are changing and pre-service teacher training has recently been introduced). Most of the time, teachers joining training courses are seasoned professionals who have strong ideas about the didactics of their discipline and who feel the need to develop professionally and update their knowledge; training offers them an opportunity to break out of the cultural isolation that all too often the school or work setting casts them in. Quite clearly, therefore, training courses addressing student teachers are not always applicable to the context of in-service training, even though the creation of a virtual community of teachers and student teachers may have distinct advantages.

3. Project Development

Going back to the T3 Project, January 1996 marked the official start of phase one, which ended in 1997 with course planning and production of related teaching materials. During phase one, each partner contributed to the development of the various initiatives by providing feedback and suggestions about the methodology, with special attention to aspects affecting applicability to the national context. Despite this mediation effort, each course has a distinct «house» style which on the one hand reflects its designers' ideas about how telematics should be applied to teaching and, on the other, indicates how teacher training is approached in each country.

Following the withdrawal of one of the partners from the project in September 1997, ITD took over a sub-project focusing on environmental education, a field in which the institute has gained considerable experience through its involvement in nationwide teacher-training projects. In addition to its original tasks, the institute was to lead the development of an on-line course in environmental education for teachers and student teachers in partner countries.

In the second and final phase of the project, completed in December 1998, the various courses produced were tested and evaluated at an international level. The individual partners handled the delivery of their own courses and co-ordinated their own country's participation in other partners' courses. For instance, ITD led a course in environmental education called EuMEDEA involving Italian, Dutch, British, Portuguese and Finnish teachers [Midoro et al, 1998]. At the same time, it promoted Italian participation in the other courses, following the guidelines agreed on with the respective leaders and using the educational material they provided. Needless to say, one of the main sore points in all this was language: all the course material was to be produced in English and, what's more important, the courses called for synchronous and asynchronous interaction between participants and tutors through computer networking (email, computer conferences or video conferences) that was conducted exclusively in English.

3.1 Features of the T3 Courses

A full description of the various courses developed within T3 would be way beyond the scope of this paper. However, something ought to be said in order to clarify the various features of the approaches adopted. As mentioned above, various disciplinary and inter-disciplinary subjects were involved. The courses covered a range of school levels from primary to upper-secondary. Finally, the role of computer networking was freely interpreted by the partners: for some, it merely represents a way to reach a vast audience quickly and effectively; for others, it works as a dissemination tool and a study topic at the same time. For example, the T3 mathematics materials are web-based but nonetheless reflect a teaching methodology that mostly ignores the use of communication technology. By contrast, the courses addressed to foreign-language teachers focus almost exclusively on the use of this technology in teaching a second language.

3.2 Collaborative Learning versus Individual Study

The very concept of a course seemed to differ as widely as the geographic co-ordinates of the various institutions. Take the Italian (and Finnish!) idea of a course: something with starting and closing dates, a modular structure and specific activities to be carried out by students, whether individually or in a group, guided by a tutor or an expert in the contents.

In stark contrast, the British partners who headed the sub-project for librarians see a course as a set of materials and resources for individual learning that can be accessed by visiting a purposely set up web site; consultation is thus free of time and method constraints, and totally independent of any structure (excepting that of the web site itself)[Pye & Myhill 1997].

The way in which computer conferences and discussion forums are utilised also varies substantially from course to course. Some adopt collaborative learning strategies and impose a well-structured (mainly asynchronous) communication process which is generally designed to support project work or pursue pre-set objectives within a given time frame. Other courses adopt a less directive approach, allowing free discussion areas though not encouraging interpersonal communication, which isn't considered essential for learning. Obviously, this divergence reflects different use of the potential of telematics: in the former case, the potential of interpersonal communication is exploited to the full, while in the latter telematics is mainly used as a means for accessing information.

As is often the case, the projects that have been the most successful are those that have struck a balance between the two extremes. Let's consider the Design and Technology course [Pulkkinen & Ruotsalainen 1997] developed by Finnish researchers. This course was run by an international pool of tutors addressing some 150 participants of four different nationalities: Finnish, Dutch, Italian and British. The tutors' role here is to set tasks to be carried out within a deadline, comment on participants' work, and stimulate and co-ordinate discussion.

It is imperative, especially in courses with so many students, that the virtual community should quickly acquire a social structure of its own, and that all community members are clear about their duties and are able to establish appropriate relationships with their interlocutors. Each student in the Design and Technology course was set a series of tasks to perform:

- selecting a subject to focus on, obviously related to the course contents; a brief essay or assignment was to be produced on the subject and published on the WWW by the end of the course (the technology used is the Proto environment, developed at Oulu University, which allows development of web-based environments including a course website, a structured discussion area and a web editor for students);
- deciding whether to handle the subject individually or in a group, and in the latter case choosing the other group members in accordance with the topic for investigation;
- locating a peer or group of peers outside one's own work group that is dealing with a similar subject and then exchanging feedback on the respective work, both at the end of the course and, even more importantly, while work is in progress;
- producing and publishing on the WWW a report on the chosen subject with the help of tutors and the peer group, or any other participant wishing to join in the discussion and provide comments.

During the project, it became clear that participation in courses of this kind requires a certain familiarity with the methods and technologies involved, as well as a certain degree of autonomy in learning. In the approach adopted, contents are not served up on a silver platter by a teacher or expert, but rather they are explored by each participant with the aid of tutors and peers. Tutor support is more oriented towards offering advice or perhaps posing questions than providing solutions. The Finnish students, who were obviously more accustomed to this working method, came through with flying colours. But the others too, after some understandable initial floundering, eventually managed to get to grips with the course. Many remarked in hindsight that this kind of approach puts the process before the product and is most effective when the participants are professional people (for instance in-service teachers), who often have much to learn but also a lot to share with peers and tutors.

3.3 Synchronous and Asynchronous Communication

From the above description, it is probably quite clear that asynchronous communication was used much more frequently than synchronous communication, and that textual communication prevailed over multimedia communication. The main reasons for this are that the language problems are more easily solved in asynchronous communication, that few schools (let alone individual teachers) in most European countries have access to videoconferencing systems, and that institutions and education systems in these different countries vary widely in terms of pace and organisational structure, so that a loose synchronisation is easier to achieve that a tight one. Nevertheless, the establishment of virtual communities such as the one created within ITD/CNR's EuMEDEA course can undoubtedly be hindered to some extent by the lack of face-to-face interaction and direct verbal exchange with 'eye contact'. This lack of human contact with peers and tutors may have a strong effect on some of the participants. In previous, smaller scale national projects it had been possible to organise some face-to-face meetings, held either at the outset to encourage and speed up ice-breaking, or at the end to support and focus the final effort of evaluating the whole process. Conversely, with an international project involving thousands of European students, organising face-to-face meetings for course participants was unthinkable. Nonetheless, it was possible to resort, at least in some cases, to fairly satisfactory surrogate events based on video conferencing. For instance, students enrolled in the EuMEDEA course for environmental education were able to participate in a multipoint videoconference with students in Utrecht (Holland), Oulu (Finland), and Exeter (England), and with tutors and students in Genoa (Italy). Although multipoint video conferences call for fairly disciplined interaction and require a discussion moderator to direct traffic, one such event can achieve a better effect (in terms of familiarisation) than a series of introduction messages from the various participants. It has to be said that in our case, however, the less than perfect audio and video quality limited this effect to some extent. The desktop video conferencing system we used [2] and a bridge made available by the Dutch telecommunications provider allowed us to try out two different working modes: all four participants displayed simultaneously in distinct sections of a large window; or the mode where only the person (or group) speaking at that moment is visible to the others (as one speaker or group hands over to another, the image on all the monitors changes accordingly). Of course the first mode is more convenient when there are four interlocutors. Anyhow, no preference emerged for one mode or the other, the main problem being the time needed to get accustomed to the way the bridge switches from one interlocutor to the other. There are in fact two aspects that participants need to get used to: the first is that the bridge switches over automatically to a new speaker when he/she starts to talk, and this means that participants need to keep silent while somebody else is talking unless they really want to take the floor. The second aspect is that there is a gap of a few seconds when the bridge switches over to a new speaker, so speakers must be aware that their first few words may well be clipped off. In the absence of a bridge for multipoint videoconferences, the next-best option is to hold several point to point videoconferences between tutors and participants, but of course this rules out student-to-student interaction and is therefore only satisfactory where socialisation is not the primary aim.

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[2] The Olivetti Personal Communication Computers provided by our sponsor Olivetti.

3.4 Virtual Laboratories

Some of the above-mentioned courses provide certain environments that we defined as 'virtual laboratories'. One example can be found in the Design and Technology course, which focuses mainly on the application in lower-secondary school of LegoLogo language, a programming language for controlling models made out of plastic Lego bricks - Legologo programs operate small electric motors allowing the model to move. The course designers developed a toy train located in Oulu, Finland which participants can operate by remote control through the Internet. The virtual laboratory has a specially-designed window where users write a program that can either move the train or raise and lower the bars of a level crossing. The program is sent to Oulu and executed in the actual laboratory. A camera focused on the train records the movement and this outcome is relayed back through the Internet and displayed in another window. In this way, the course's remote students can investigate problems in LegoLogo programming without the expense and waiting time involved in buying the original kit.

The combination of virtual laboratories (based on a constructivist approach to learning by trial and error) and collaborative learning (based on Vygotsky idea of the importance of social construction of knowledge) not only proved to be very effective but also supportive from the tutor's point of view: in many cases answers to students' questions were actually provided by other students before the tutors got a chance to read them!

4. Conclusions

The T3 project has adopted an experimental approach on a fairly large scale to address a series of areas that are of particular interest throughout Europe and especially crucial in Italy - areas such as pre-service teacher training, educational technology used for teachers' professional development and as a tool for innovation in education, distance learning, and so on. It's no coincidence that these areas are receiving generous funding from the European Community, as well as attracting considerable debate in journals. The idea is that great strides can be made through synergy between European countries that goes beyond the research field to involve large sections of the productive population as well as those working in education. Hence a project like this can have a remarkable impact but the effect may be even greater if an effort is made to create something that will last beyond the project's closing date. As mentioned before, some of the T3 courses have been adopted by their originating institutions and are being offered to students even after the end of the project. A number of these have attracted the interest of students in other European countries, even outside the original consortium. Nevertheless, the costs of these courses remain high and commercial marketing seems an unrealistic option, especially considering that in Europe the education sector has yet to become a real market [Davis 1999].

From the point of view of the institutions involved in T3, I believe one of the major achievements was managing to strike a balance between the various approaches in order to create courses that can be used in different countries by students with different learning habits and cultures. Limits in the transferability of approaches are often related to limits in learning ability, and proposing Europe-wide courses may help each country to overcome its individual limits (seen for example in the fact that Italian students were less autonomous than Finnish students and were forced to overcome this problem when tackling a course designed by the Finnish partners). A second, important achievement of this project is the creation of a network of institutions able to develop and run international courses jointly. This network is, hopefully, only the kernel of a future wider network of teacher training institutions.

5. References

Davis, N., & Prosser, D. (1999). *T3 Final report.* http://telematics.ex.ac.uk/T3/deliver.htm

Midoro, V., Briano, R., Persico, D., Sarti, L., Trentin, G. (1998). Eumedea: a European on-line course to train European teachers in environmental education. In Davies G. (ed) *Teleteaching '98 Distance Learning, Training and Education.* Proceedings of the XV IFIP World Computer Congress, Vienna/Austria and Budapest/Hungary, 725-736.

Pulkkinen, J., & Ruotsalainen, M. (1997). T3, Telematics for Teacher Training: Lego Construction Kit goes on the Web. *Euroameritel-97*, San Jose, Costa Rica, November 1997.

Pye, P., & Myhill, M. (1997). Training the Resourcers - Librarians, teacher-training and Telematics in the European context, in Baggott, L. (ed) *Conference proceedings CAL97*, Exeter, 232-236.

Hypermedia Educational Information System for Faculty

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Abstract: This paper describes a Hypermedia Educational Information System for Faculty that aims at designing a knowledge pool about the use of NICT (New Information and Communication Technology) in an educational framework. This System addresses teachers, and is created and maintained by experts (teachers, pedagogues, technicians), it's a user-friendly tool, allowing remote authoring, consultation and collaborative work via the WWW. The first part of this paper reports on a design approach to construct such an information system on distance education themes (techniques, solutions, products, advantages etc.), while the second part proposes to validate the approach with a prototype based on a multi-dimensional document authoring tool.

1. Introduction

Nowadays the WWW has captured a great interest for educators simultaneously around the globe because current available technology allows a great easiness in real time access to interactive classroom and causes teachers to re-think the very nature of teaching and learning.

It has become evident that there is a need to help teachers use technology effectively. Not only do they need to become proficient as users (acquire new technical skills), but they also need to learn to use the technological means efficiently as an educational tool. As the teachers are the main promoters of any innovative activities in education, it is of vital importance to facilitate their efforts to integrate new technologies - like multimedia software and telematics - into their work. The answer to the question: "why should I bother with new technologies? I have got classes to teach, assignments to grade, faculty meetings to attend..."[6] is not the matter of this paper , we propose instead to give an information system whose aim is to share knowledge between experts and teachers in order to satisfy the need of information on the questions: "Why?, How?, Where new technologies in education?". In this paper we illustrate a scientific design approach for the organization of the information system on NICT(New Information and Communication Technologies) in educational applications and its implementation in a hypermedia educational information system built to facilitate the access for faculty and to allow collaborative work between experts. Many projects at present deal with the creation of an Information System for faculty development in NICT (NEPTUNO[1], CPTIC[2], FACILE[3], LTDI[4]), but as far as we know, none of them give a collaborative environment in which experts as well as novice from all over the world can contribute with information from pedagogy to technology on distance teaching and learning. The public who will benefit from this Information System is the vast category of teachers who need to know the impact of using NICT for their courses, or those who already know the advantages, but need specific technical solutions.

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[1] http://fuev.adeit.uv.es/neptuno/english

[2] http://wwwedu.ge.ch/cptic/

[3] http://www.cfp.upv.es/FACILE/Leaflet/

[4] http://www.icbl.hw.ac.uk/ltdi/

In section 2 we will delineate a knowledge pool on distance education to approach all the aspects, form pedagogical to technological, to highlight the multi-dimensional structure of the information and the need of an authoring system to support its generation and the non-linear access. For this purpose, in section 3 we will describe the function of an Hypermedia Educational Information System for faculty, built on the WWW platform. The Information System will be fed by many experts with pluridisciplinary competences to create a shared competence pool. To realize the Information System we used a multidimensional hypermedia authoring tool (MDAT) developed in the framework of MEDIT project [1]. MDAT is an authoring system conceived to allow the design of multidimensional hypermedia documents. It allows an easy organization of the content in a three structure, and the automatic creation of its consultation system. We conclude the paper with a description of the present state of the project and the planning for the future evaluation and works.

2. A knowledge pool for the use of new technologies in education

The technology skills development for faculty willing to integrate the use of technology in their teaching can be modeled in a four phases process:

Awareness Goal Development: The focus of this first stage is instructional. It provides the educator with an in-depth experience with the educational hardware and software available in his/her teaching area. Faculty will feel comfortable in using some technology based teaching in their classroom. They develop skills in adapting standard software to classroom needs. With this experience comes the development of skills necessary to use technology efficiently in teaching.

Curriculum Integration: The focus of the second stage is the development of curriculum enrichment with educational technology. It offers the opportunity to integrate technology based learning into the regular curriculum of the classroom.

Strategy Integration: During stage three, faculty review their present curriculum and course management needs. Faculty begin to integrate appropriate educational technology applications and management strategies. This stage provides the framework necessary for the educator to develop out-reach opportunities to share their expertise with other colleagues.

Implementation Evaluation: Once there is a significant mass of faculty incorporating educational technology applications into their teaching, it is possible to provide continuous evaluation and updating. Faculty share their knowledge with other colleague. There are various benefits in supporting this model for the faculty members, such as the opportunity to develop educational technology skills that can be used in the classroom, and the skills acquisition in upgrading and restructuring their curriculum. The teachers' approach to the integration of NICT in their teaching material, can be seen from two points of view: pedagogical and technical.

Pedagogical aspects: The pedagogical aspect deals with the organization of the knowledges in order to effectively use the NICT in educational context, the re-engineering of the course content [4], as well as the reorganization of the roles of involved actors [7]: teachers and students. Teachers have to get acquainted with the use of technology, learning to reorganize the course content to go toward a student-centered teaching. They have to learn to keep an affective interaction and motivation in students, depending on the level of integration of technology in the course. Students on their own, have to learn to use technology in a self-paced, autonomous and self-directed way. The course content has to be re-engineered in order to satisfy demands and needs. The re-organization strongly depends on the level of integration of learning technologies in instruction [5] and involves all the traditional course components [4].

Technical aspect The technical level deals with the problems of choice of technologies and media suitable for targeted pedagogical purposes. This is not merely a classification of available system to allow integration of technology in education, but a complex investigation of technical platform, services available and applications in order to improve the effectiveness of learning.

Figure1: Pedagogical and technical aspects

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Fig. 1 shows a representation of the relation between pedagogical methods and objectives to attain in teaching [3], with respect to three categories of technologies (distributive, interactive and collaborative). Distributive technologies (for instance video-conferencing to support lectures) allow an information transfer for a typical instructor centered approach; interactive technologies (for instance simulations) allow knowledge transfer for a learner centered approach, while collaborative technologies (for instance group decision making system) allow knowledge sharing for a team centered approach. In order to be effective and successful, an educational system has to integrate all these technologies.

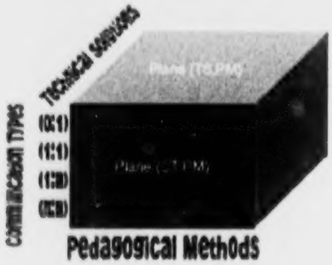
Technical Solutions
Plane (TS,PM)
Communication Types
(0:1)
(1:1)
(1:n)
(n:n)
Plane (CT,PM)
Pedagogical Methods

Figure 2: Three-dimensional Information System space

A three dimensional representation of the information structure (Fig. 2) can be the base for the development of the information space, relating pedagogical methods and technological solutions in order to analyze for each teaching aim, the benefits, the applications, the examples, the constraints of a specific solution. This relation can be parameterized with respect to the communication type that the medium can support. The communication type between teachers and students in a generic education environment (distance or traditional) can be classified as [8]: individual study (01), tutoring (1 1), teaching (1n), discussion (n n). Depending on the type of communication supported or available, a teacher can attain different aims with different solutions. Referring to figure 2, different competences can contribute to this Information System in different plans of the space; instructional designers and technicians will cover the aspects of technical solutions compared to pedagogical methods (Plane(PM,TS)) etc. This approach allows an easy access to the a specific view depending on the targeted interest. This information may be seen using a table layout as a projection, mapping the multi-dimensional logical structure into a two dimensional visual space. Very often dimensions are identified by table headings; intersections of rows and columns provides then the relationship between items and headings [10].

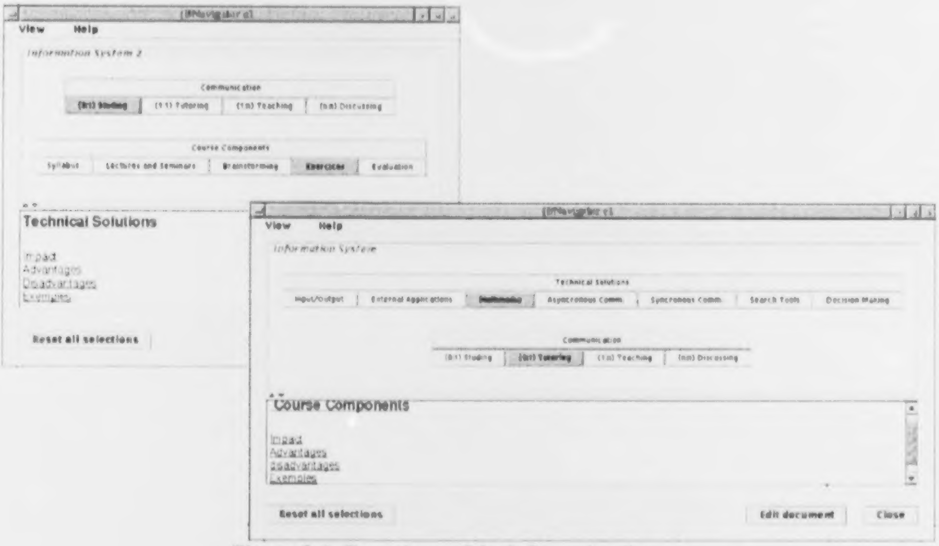
View
Help
Information System 2
Communication
(0:1) Studying
(1:1) Tutoring
(1:n) Teaching
(n:n) Discussing
Course Components
Syllabus
Lectures and Seminars
Brainstorming
Exercises
Evaluation
Technical Solutions
Impact
Advantages
Disadvantages
Examples
Reset all selections
View
Help
Information System
Technical Solutions
Input/Output
External Applications
Multimedia
Asyncronous Comm.
Syncronous Comm.
Search Tools
Decision Making
Communication
(0:1) Studing
(1:1) Tutoring
(1:n) Teaching
(n:n) Discussing
Course Components
Impact
Advantages
Disadvantages
Exemples
Reset all selections
Edit document
Close

Figure 3,4: Two views of the Information System

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Sample of the possible table views are shown in the Fig. 3 and 3. The first table compares Technical solutions with respect to Communication types, analyzing the effects (in term of impact, advantages, disadvantages and examples) of each possible solution or tool on all the course components. The second table relates the traditional course components with respect to the communication types, giving as a result the impact, advantages, disadvantages and examples of the available technical solutions. It appears evident that feeding such a space with information would give an excellent educational Knowledge pool suitable for faculty, built by faculty itself as well as experts in a collaborative, multidisciplinary way.

2. Hypermedia Educational Information System

The conception and design of an hypermedia product is a hard task to carry out, due to the lack of design methods and the subjectivity of the process. Our approach provides a system easy-to-create and use, to support authors in the creation of their multidimensional hypermedia products. It permits an easy non linear organization of the content (hypertext structure) and automatically creates the Web interface for the navigational system. In the Information System we include three categories of actors with different access privileges: the system manager who organizes the access rights and assures the technical maintenance, authors (technical or pedagogical experts) and users (teachers, professors etc.). The Hypermedia Educational Information System is realized with MDAT (Multidimensional Data Authoring Tool) implemented in the framework of MEDIT[5] project at the Swiss Federal Institute of Technologies [9]. MDAT is a hypermedia authoring system allowing an easy representation of multidimensional hypermedia information. Let's take the example of Fig. 2, where the Information System is based on a three-dimensional space. The access to every information is realized on planes spatial projection (communication type, pedagogical solution and technical methods). MDAT proposes an approach to support the non-linear organization and representation of the multi-dimensional information space basing on hierarchical trees method as illustrated Fig. 5 left part.

In order to visualize and navigate in the information, we implemented two kinds of interfaces: the table layout shown in Fig. 6 and the tree layout shown in Fig. 7; the table contains a set of logical dimensions and a set of items. The logical dimension include headings which may themselves contain sub-headings. Each item of the tableis connected to at least one rubric in each dimension.

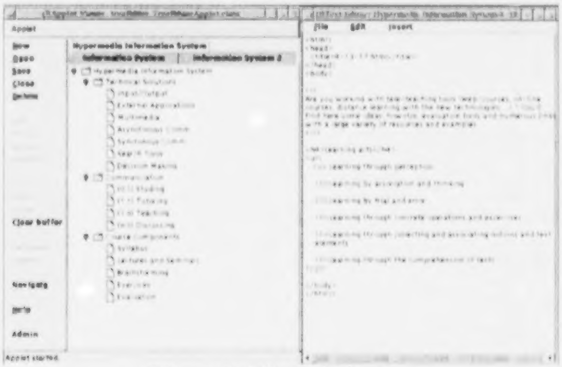
Applet
New
Open
Save
Close
Delete
Clear buffer
Navigate
Help
Admin
Applet started
Hypermedia Information System
Information System
Information System 2
Hypermedia Information System
Technical Solutions
Input/Output
External Applications
Multimedia
Decision Making
Syllabus
Brainstorming
Exercises
Evaluation
File
Edit
Insert

Figure 5: Editor window

3. Characteristics of the Information System

The Information System has two main characteristics: it is an authoring system, and it offers a user-friendly navigational support.

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[5] http://medit.epfl.ch:4444

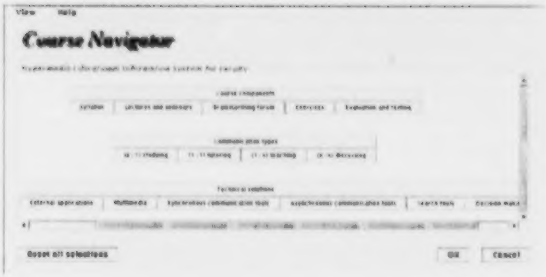
View
Help
Course Navigator
Reset all selections
OK
Cancel

Figure 6: The tabular navigational interface

Authoring system: it is a complete environment for management and consultation, allowing remote management functions (create, modify, delete etc.). It allows a simultaneous remote edition of the same document by a collegiality of authors [2] geographically separated, writing on the same subject. The system is easy to update in the conceptual organization of branches and leaves of the tree. Fig. 5-left part, illustrates the interface for the creation of the tree structure. Once the tree has been constructed, the Information System automatically creates all the files corresponding to the combination of the leaves. Files can be edited with the edition system shown in Fig.-5 right. The authoring system supports the on-line edition directly in HTML, or the uploading of HTML or LateX files from the client. This solution leaves the freedom to the author to choose

User friendly navigational support: the main reason of the success of hypermedia system is the navigational easiness in an information network. However the goal of these kind of systems remains the customized information retrieval in order to avoid the disorientation effect. There are two complementary approaches; navigation which allows a free and informal exploration, and interrogation, in which information are stored in a database and access is made by requests. This Information System offers a navigational access allowing a non-linear exploration of the content with two graphical representations: the tree and the table access. The access to the relevant information is provided by the navigational interface (Fig. 7-top). Fig. 7-bottom shows the browser with information concerning the themes chosen with the tree control(highlighted items). The content (file, images, links etc.) has been taken from the NEPTUNO Open Distance Learning Laboratory[6] and has been introduced in the Information System using its authoring tool. his/hers most suitable editor (WYSIWYG HTML, HTML, LateX, Word, etc.). The user can also preview the final layout of his/her document an has the possibility to easily insert additional formulas, images and links.

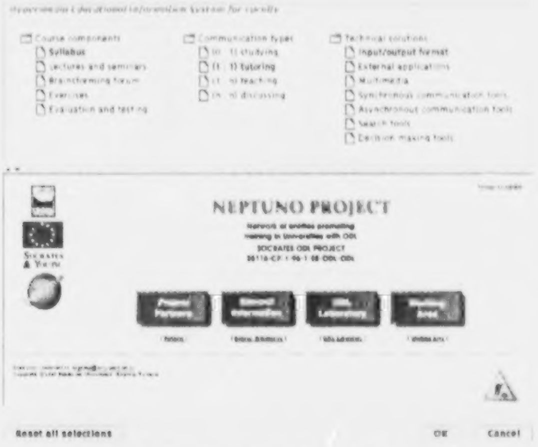
Course components
Syllabus
Lectures and seminars
Brainstorming forum
Exercises
Evaluation and testing
Communication types
(1 : 1) tutoring
Technical solutions
Input/output format
External applications
Multimedia
Synchronous communication tools
Asynchronous communication tools
Search tools
Decision making tools
NEPTUNO PROJECT
Network of entities promoting
training in Universities with ODL
SOCRATES ODL PROJECT
Reset all selections
OK
Cancel

Figure 7: Remote Control and content

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[6] http://fuev.adeit.uv.es/neptuno/english/

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4. Future work and Conclusion

In this paper we firstly described a model for the representation of a knowledge pool on the use of Information technology in education, organized in a multi-dimensional information space. The most interesting feature was the idea to represent a n-dimensional space in a tree structure organization, allowing the creation of a forest of trees which can be projected in the space giving two access to the same information (tables and trees). We then presented the implementation of this Information System based on MDAT (Multidimensional Data Authoring System). The originality of this tool lays on the fact that it doesn't impose a conception methodology of hypermedia products, but on the contrary it offers a great easiness letting each users to create his/hers own document structure. Moreover this system offers easy support features, collaborative work, remote authoring and user friendly navigational systems. At present the Information System is not yet completed; the pool of experts and authors is being formed within the framework of the Swiss national project CR2000[7], and it has been the object of a European project proposal for the Information Society and Technologies Vth Framework Program. The Information System will also be used in framework of the program TRIO-TELEFOR[8], to support teachersdevelopment in the thematic network for higher education and life-long training with new technologies. Many points have still to be developed in the next future; the improvement of the authoring interfaces, theinclusion of new navigational interfaces (hyperbolic tree and mind map) the management of collaborative functionalities and privileges, and the tracking of the user's navigational paths, which will make the navigation easier and customized.

5. Bibliography

[1] Abou Khaled O., Karacapilidis N.I., Rekik Y.A. and Vanoirbeek C. Medit: A web-based environment for advanced pedagogical issues. In Proceedings of the 4th International *Conference on Computer-Aided Learning and Instruction in Science and Engineering* CALISCE'98, pp.325-333, June 1998.

[2] Balpe J.P., Lelu A., Papy F. et Saleh I. *Techniques avancées pour l'hypertexte*. HERMES, 1996.

3 Berger Kramhöller S. *Plato: Collaborative technologies for learning scenarios*. Friburg, June 1998.

[4] Collis B. Pedagogical reengineering: A pedagogical approach to course enrichment and redesign with the www. *Educational Technology review*, Autumn/Winter 1997.

[5] Marco R. et Francés V.L. World wide web education and university teaching: a multiple challenge. In Proceedings of the 1998 *EDEN* conference, volume 1, pp. 265-272, June.

[6] Owston D. Ronald. The world wide web: A technology to enhance teaching and learning? *Educational Researcher*, 26(2) : 27-33, MARCH 1997.

[7] Parker A. A distance education how-to manual: Recommendations from the field. *Educational Technology Review*, Autumn/Winter 1997.

[8] Paulsen M.F. Some pedagogical techniques for computer-mediated communication. *Collaborative Dialogues technologies in Distance learning*, pp. 34-45, 1994.

[9] Pettenati, M.C. and Abou Khaled, O. and Coray, G. and Giuli, D. Development of a distance education environment for university courses: Medit. In Proceedings of the 1998 *EDEN* conference, volume 2, pp. 465-471, June 1998.

[10] Vanoirbeek C. Formatting structured tables. In EP92 Proceeding of *Electronic Publishing* 1992, pp. 291-309.

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[7] http://www.ndit.ch/5000/

[8] Tuscany regional project for innovation of education and training process.

The Shuffler:
Software for a World-Wide-Web Based Form Routing System

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Abstract: This paper describes the design and development of The Shuffler, a software system created to help remove the conventional shuffling of paper from the routing of forms in the workplace. It is designed to run entirely via the WWW, either on Intranets or using encryption on the public Internet. The software allows a set of administrative offices to create, edit, route, verify, and archive paper forms. It includes a security system to authenticate the identity of the users as well as to authorize them. The system software is designed to be as generic as possible in order to allow it to be used by any office as well as on almost any computer and operating system.

1. Introduction

There are many reasons for building WWW-based software that mimics the process of using paper forms. Major motivations are the desire to reduce or eliminate the use of paper and the desire to reduce the amount of time necessary to complete the processing of a form. This paper covers the creation of The Shuffler: what it is, how it was designed, and preliminary information about how effective it is.

What is The Shuffler

The Shuffler is a WWW-based form routing system. Businesses require large quantities of paperwork, most of which is based on standard forms. Forms are necessary for consistent management of approvals, authorizations, purchasing, and other functions. The business chain-of-command often requires that these forms must be approved and viewed by a varying number of people.

The Shuffler allows an administrator to replace existing paper forms with electronic versions that are routed automatically. The benefits of saved paper and time are obvious. In addition, an electronic workflow management system allows one to track a form, avoid lost paperwork and tardy processing, and allow efficient management.

The Shuffler's purpose is to:

1) design and implement a form via the WWW
2) provide authentication of users involved with the creating and routing of forms
3) provide a means of notification that an action is requested on a form
4) provide a scalable and efficient database for storage and retrieval of forms
5) provide an electronic archive that can be searched and efficiently archived for long-term storage purposes.
6) ensure the security of sensitive business information.

The Shuffler is made up of a number of components including the interface, database, and routing mechanism.

A Shuffler Scenario

A purchase order is a good example of a form that is typically implemented in paper and is easily modeled in The Shuffler. A typical pattern that a purchase order follows is that the purchaser fills out the purchase order form with pertinent information. This form is sent to one or more supervisors for signatures, then routed to a purchasing office for processing. It is also not unusual for multiple supervisors to sign off on the form. The Shuffler can be used to replace this entire process by 1) allowing the form to be created electronically, 2) taking care of the routing and notification, and 3) providing a means for proper authentication and authorization. In addition, The Shuffler can perform the processing that is necessary at the end such as entering the purchase information into a master purchasing database in the purchasing office.

2. Interface

The Shuffler utilizes a World Wide Web-based interface. Use of modern browser and server technologies facilitates a efficient client-server application and a consistent well-known user interface methodology. Other than basic browser requirements, custom software does not have to be manually installed on client machines. In a large business environment such as a University, this is a valuable advantage.

The interface has six main sections – security, the user manager, form creation screens, form initiating and routing screens, status screens, and viewing screens.

2.1 Security

The login screen must precede all access to any function, except certain guest functions, in The Shuffler. The existing system utilizes Secure Socket Layer so that all transmissions between the client's browser and the WWW server are encrypted. This provides integrated security, which is difficult to circumvent.

The Shuffler has an internal authentication system and can also accommodate external systems such as Kerboros or X.500. This dual authentication capability is implemented in the secure server environment by providing a check in the authentication scripts for any outside authentication agent. Use of the Shuffler in multiple departmental environments with varying security requirements led to the installation of this more flexible authentication structure.

2.2 User Manager

The user manager allows an administrator to add and remove users in The Shuffler database. As a security sensitive system, The Shuffler must have authorized users explicitly identified. User maintenance is done one user at a time, though group management features have been suggested as future additions to the system.

2.3 Form Creation

Creating a new form in The Shuffler is not a system-administrative function. Managers and business administrative personnel create new forms. Consequently, form creation must be an easy-to-use process.

To create a new Shuffler form, the user fills in the necessary information using a browser-based form creation interface. The interface allows the user to enter a name for the form, a description, an *annoyance factor*, a routing method, and a default mail-to person.

The name and description are self-explanatory. The annoyance factor is the number of hours that The Shuffler will wait before sending an additional message to a routed-to person. This feature is described in The Shuffler Scheduler (see section 6.3).

The routing method is the type of routing that is desired for a particular form. There are two routing methods available: serial and parallel. Serial routing is the default method. In a serial route, the initiated form travels from one user to the next in the listed order. During parallel routing, the initiated form is sent to all people in the list of selected users simultaneously. In the preliminary usage of The Shuffler, the parallel routing method, though available, has not been used at all.

The default mail-to person is a user that can be selected to receive the completed form by default. This implies a one-stop shuffle. That is, when an instance of the form is created and filled out, the completed form is routed only to the default mail-to person. This is useful for actions that only require one step (e.g., a requests for a ream of paper).

Once the initial configuration information is provided, the user can then add fields to the form. There are two types of fields that can be placed on a form: system fields and user fields.

System fields

System fields are optional fields that are common in form designs and will be dynamically completed by The Shuffler. The system fields are FROMFIELD, CURRENTDATE, USERNAME, USERADDRESS, EMAILADDRESS, and PHONE. As an example, FROMFIELD provide a means of dynamically placing the form initiator's name and department on the form. At initiation time, the initiator's name and department will automatically appear. The rest of the system fields are similar in that by placing them on a form, at initiation time, the dynamic information will be displayed.

User-defined fields

There are three types of user-defined fields – static, regular, and editable.

There is only one static field, the 'static text' user field. It is used to provide fixed information such as instructions, headers, or other information that will appear the same way every time a particular form is initiated.

Regular user fields are those that are defined at design time, but are initialized at form initiation time. That is, the initiator fills in the values for these fields. There are six regular user fields as follows:

Paragraph

This provides a user with a variable sized text area for typing in text.

Date	This prompts the user to enter a date.
Number	This prompts the user to enter a number (it expects numeric input).
Checkbox	This prompts the user for a yes/no style answer.
Textbox	This prompts the user for input. It is a one-row text line.
Selectbox	This provides the user a list from which they are expected to choose an item.

Editable user fields

Editable user fields are those that are defined at design time, but are completed during the routing of the initiated form. That is, at some point during the routing of the form, one or more users will set the values for editable fields.

There are six editable field types that are identical to the regular field types listed above. The difference between the two is that editable fields are filled in *during* routing. Editable fields are not available at form-initiation time. They are only available on routing steps after initiation.

At this point, the form-creation editor is very simple in its methods of adding information to a form. Subsequently, it is difficult to do much customization at form-creation time in terms of adding logos or editing exact placement of fields. As this would not be sufficient in most cases to provide the needed look an feel to an electronic form, a customization feature exists. All created forms are stored in the database as HTML with Shuffler directives embedded. To customize a form, one only needs to edit the corresponding HTML with a favorite HTML editor while being careful not to remove the Shuffler directives. This customization requires some additional skill, but is easily accomplished.

2.4 Form Initiating and Routing

Once a form has been created, it can be routed. To intiate the routing of a form, a user selects the form from a list of available forms and fills in the appropriate information. At the bottom of the form is a field for selecting to whom the form should be routed. This field consists of two parts. One is a list of possible users, and the other shows the list of users chosen to receive the form. The user double-clicks on the users to select them. The order in with which users are selected is the order that the form will be routed. When all information has been completed, the 'Start Shuffling' button is pressed, and The Shuffler begins routing the form. If there are editable fields on the form, The Shuffler will then request that the user indicate which of the chosen users gets to fill in information and which fields they are allowed to edit.

The Shuffler performs validity checking at all subsequent stages of processing after the selection of "Start Shuffling". Validity checking is implemented through validity scripts. These are scripts (files) that The Shuffler will execute in order to ensure that a form is filled out properly. For example, if there is a date field on the form, a validity script can make sure that a proper date was entered, not a string or integer. Validity scripts are an advanced feature of The Shuffler and are typically created by a system administrator. There is a standard set of scripting templates provided with The Shuffler to make the creation of validity scripts simpler. Upon submission, The Shuffler checks for the existance of a validity script and if one is found, executes it. Validity scripts are particularly useful for ensuring specific formats of user and inventory ID values, preventing duplicate purchase order numbers and many additional customization functions.

2.5 Form Status

Once a form instance has been routed, status information becomes available. The status information is retrieved from one of three screens. The first screen shows information about forms that are currently being routed. Immediately available from this screen is information describing the name of the form, the date and time the form was initiated, who initiated it, the current status of the form, the subject of the form, and the response of the user. The subject field reflects the type of the form that is en-route. In addition, a hyperlink on this field will take the user to a form viewing screen described in the next section. The second screen shows information about forms that are complete, meaning they have completed their routes. This screen offers a way to revisit completed forms.

The third screen provides a search facility for the Shuffler forms database. This is particularly useful when attempting to answer questions about forms that have been moved to archival storage. The Shuffler dynamically provides a query-by-example type screen based on the fields in the database.

2.6 Form Viewing

The form viewing screens can be reached in two ways. The first way (the way that most people are expected to view the forms) is via a specific URL that is provided in the email message a user receives. This URL, when provided to a WWW browser, takes the person first to a login screen, and then directly to the form indicated. There are two views in which a user may see form information – Edit-Mode and Read-Only. The only way a user may see a form in Edit-Mode is if it is currently that user's turn in the route. If the form is currently pending another user's interaction, then a Read-Only view is displayed.

Viewing in Edit-Mode

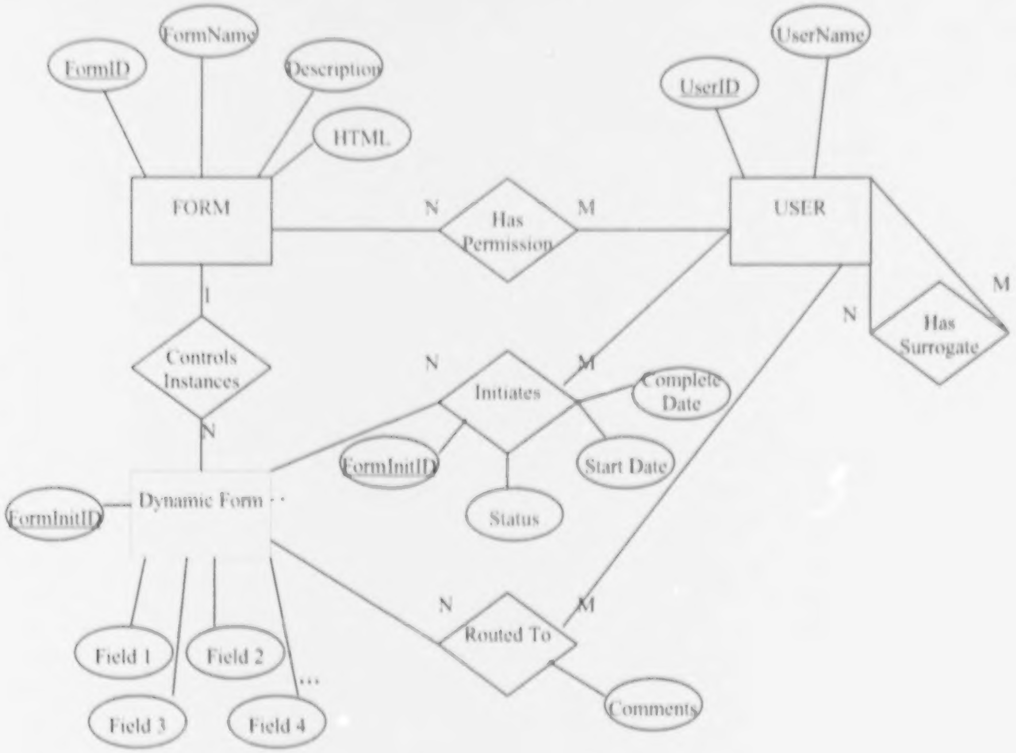
When viewing a form in edit-mode, fields that are meant to be edited by the current user are editable. The edit-mode screen always provides a field for entering comments as annotations on the form. Even when there are no other editable areas on the form for the user, the user is able to enter comments. Areas that are editable by a particular user are indicated with his/her name displayed next to the area.

Viewing in Read-Only Mode

Any user involved in a routing process can view a form in read-only mode. All edits made by users during routing, as well as all comments made by users, will be displayed. The current read-only status for each user is determined by the routing mechanism and dynamically changes as the form proceeds through the routing process.

3. Database

The database for The Shuffler was designed to work via Microsoft Access or Microsoft SQL Server. Smaller installations use the significantly cheaper Microsoft Access while Microsoft SQL server allows for scalability to larger installations. The choice of which database system to be used is selected during installation of The Shuffler. For either database system, the design of the tables that hold the information for the created forms as well as the form instances is the same. Following, is an entity-relation diagram of The Shuffler database.


FormID
FormName
Description
HTML
FORM
UserID
UserName
USER
N
Has Permission
M
1
Controls Instances
N
M
N
Has Surrogate
N
Initiates
M
Complete Date
FormInitID
Start Date
Status
FormInitID
Dynamic Form
Field 1
Field 2
Field 3
Field 4
...
N
Routed To
M
Comments

4. Routing Mechanism

The strength of The Shuffler is in its routing mechanism. This mechanism includes The Shuffler Engine, The Shuffler Mailer, and The Shuffler Scheduler. This mechanism controls everything users see and maintains the data for all Shuffler forms.

4.1 The Shuffler Engine

The routing mechanism for The Shuffler is a program that processes forms as they are being initiated and subsequently routed. The program implements the security features, provides the display screens, controls the mailing of notifications, and handles errors.

As mentioned earlier, there are a number of security features designed into The Shuffler. All of these features except the Secure Socket Layer are implemented via The Shuffler Engine. The engine provides a login screen and controls authentication and user access to system functions. In addition, The Shuffler Engine dynamically creates the HTML for the various screens seen by users.

Any errors that occur are trapped and monitored by The Shuffler Engine. An error log is maintained that aids in solving software problems in The Shuffler system.

4.2 The Shuffler Mailer

When a form is routed from one user to the next, an email message is used to notify the routed-to user that a form is waiting to be checked over. Currently, only the NT Server edition of IIS has a mailer, and the NT Workstation edition does not. As NT Workstation is a much less expensive platform for implementation and testing, a mailer was created that is bundled with The Shuffler.

The Shuffler Mailer was created as a Component Object Model (COM) object. The Shuffler Mailer provides methods for setting the Simple Mail Transport Protocol (SMTP) server, the subject of the email, the from-address, the recipients, and the text of the email. The Mailer than manages the transmission of the message. The email module was created as a COM object to ensure seamless integration with ASP programming.

4.3 The Shuffler Scheduler

After a form has been routed to an individual, the route stalls until the individual processes the form and continues it on its route. This could lead to a time consuming situation where one individual could hold up the completion of a form indefinitely. To combat this, The Shuffler Scheduler was created. The Shuffler Scheduler wakes up every hour and checks the main Shuffler database to see if anyone is delinquent on pending forms. If any user is delinquent, then an additional email message is sent to that person. For example, if the annoyance factor (set during form creation) on a particular form is set at 24 hours, then a new email will be sent to people who have waited more than 24 hours to respond. Additional email messages will be sent every 24 hours until the person responds.

5. Design Decisions

In the initial development of The Shuffler, many different implementation choices were available. This section describes the primary tools that were used to design and implement The Shuffler.

5.1 Tools

The primary tools used to create the WWW interface for The Shuffler are Microsoft's Internet Information Server (IIS), Microsoft's Active Server Page (ASP) technology, Java, Visual C++ (VC++) 5.0, Microsoft Visual Basic (VB), Microsoft Access and Microsoft SQL Server, and finally Microsoft Interdev 1.0. Also considered, were the various WWW browsers that might be used to act as client front-ends to The Shuffler. The browser choice was narrowed by the need to build for browsers that supported JAVA and cookies. Once that was decided, all browsers that fit were considered to be appropriate client front-ends.

Ultimately, the decision to use Microsoft's IIS influenced the rest of the choices made on tools. One may notice that the rest of the tools and design decisions are Microsoft based. The initial implementation of The Shuffler was created mainly using ASP. The Shuffler Mailer and The Shuffler Scheduler were implemented using other programming languages (VC++ and VB respectively). Within the ASP programming, JAVA was used to create a versatile selection box described earlier for use on forms when selecting users a form is to be routed to.

As described earlier, Microsoft Access and Microsoft SQL Server are the databases of choice for The Shuffler. The main reason for choosing these database systems, aside from the reasons described earlier, is that both of these databases are easily connected via ASP programming.

Finally, Microsoft Interdev is an editing tool specially designed for developing WWW applications of this nature. Interdev provided a simple arena for organizing, programming, compiling, and executing The Shuffler.

6. Preliminary Testing Data

The Shuffler is currently being used by Michigan State University's Enrollment Services division. Enrollment Services has six forms that are used in a production environment with nine more in various stages of development. Of the six forms that are in production, three are one-step shuffles. They are forms that an initiator fills out and shuffles to a processing person where they are completed. Two more of the forms are two-step shuffles. They are initiated, verified by authorized personnel, and then completed by a processing person. The last form has a more complex processing route that takes input from an initiator, sends the information by a processing person, and then the final stage of the shuffle is to update information in a master database.

7. Conclusions / Future Work

The Shuffler provides a WWW-based form routing system to a group of users. Because it is WWW-based, there are fewer restrictions on the choice of computers and WWW browsers that may be used in conjunction with it. In addition, The Shuffler database holds a record of all instances of all forms. Therefore, forms can be easily archived for storage and simple future retrieval. By deploying The Shuffler, almost anyone can provide an electronic means of routing paper in an efficient, secure, and user-friendly way.

The Shuffler is considered to be in its first fully operational version. It has many areas that can be improved for use in production. Some of these are:

1. *An improved form creation interface.* The current form creation interface is entirely HTML based and as a result is limited by the boundaries of HTML code. An interactive Java-based interface would be user-friendlier and allow greater functionality. At this point, the HTML interface will not allow a user to back up and alter field definitions. A Java-based interface would allow many additional editing functions.

2. *A form editor* (something to edit forms after creation). This is related to the previous item and perhaps would be addressed with the same Java-based interface.

3. *Addition of groups.* This would allow security to be provided at a group level and user level as opposed to just the user level. As soon as the number of users in the system becomes large (greater than 50) it may be desirable to split the management. Currently, The Shuffler allows only one administrative user.

4. *Addition of dynamic shuffling.* This is the situation where the next person to be shuffled to is chosen during the routing. This will alleviate the situation where the entire route is not known at initiation time.

5. *An ability to attach a document to the routed form.* People may want to attach external documentation.

6. *Data archival.* The ability to age archival data to a data warehouse facility allows for future review, but does not increase the primary database size.

8. References

Pfeiffer, Matthew A., *The Shuffler: A World-Wide-Web Based Form Routing System. Masters Project Report,* Michigan State University, December, 1997.

Homer, Enfield, Gross, Harrison, Francis, Jakab, Gill, Hartwell, *Active Server Pages Professional*, 1997 Wrox Press.

Corning, Michael, Elfanbaum, Steve, Melnick, David, *Working With Active Server Pages*, 1997 QUE corporation.

Danesh, Arman, *Teach Yourself JavaScript*, 1996 Sams.net Publishing.

Davis, Stephen R., *Learn Java Now*, 1996 Microsoft Press.

Coombs, Ted, Coombs, Jason, Brewer, Don, *ActiveX Sourcebook: Build an ActiveX-Based Web Site*, 1996 John Wiley & Sons, Inc.

Appleman, Dan, Visual Basic 5.0 Programmer's Guide to the WIN32 API, 1997, Ziff-Davis Press.

Li, Sing, Economopoulos, Panos, *Visual C++ ActiveX COM*, 1997 Wrox Press

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Site Maps – Where are we now?

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Abstract: An increasingly large number of WWW sites are employing the use of "site maps" as navigational aids but relatively little is known about the benefits such devices bring to the user. This paper presents a review of current site map technologies from a usability perspective. The intention of this review is to provide a sounder basis for future research and development of WWW site maps tools by clarifying existing research and identifying important issues for the future. The paper provides researchers with a classification that may be used to not only categorise new work in relation to existing research but will assist in evaluating new site map designs in terms of suitability for task.

1. Introduction

A WWW site map is essentially a visual representation of the structure of the web site. It has been suggested that such maps improve spatial context and reduce disorientation (Schneiderman, 1997), provide a sense of the extent of a particular Web site without giving detail (Tauscher & Greenberg, 1996), act as a continuously visual surrogate for the user's short-term memory (Cockburn & Jones, 1996) and support the task of browsing by providing orientation within a Web site (Morville, 1996).

There are however a number of problems associated with the current use of site maps especially those applied to sites with a large number of nodes and links, frequent changes in the network, slow or awkward responses to user control inputs and non-visually oriented users (Conklin,1987). Foss (1989) further identifies the problem of loss of semantic information due to the nature of site maps. Kerr (1990) also suggests that few users actually use navigational aids such as site maps preferring instead to construct a personal mental model through sometimes inefficient browsing. Sullivan (1996) believes that many site maps provide no inherent clues to their navigational nature and that they cannot substitute for text-based navigation methods. Hoffman (1996) has identified a number of limitations of the use of site maps for navigation including speed, complexity and maintenance. Finally, Bieber et al (1997) describe the problems of navigating site maps themselves especially when they are large or complex.

Research has yet to resolve these conflicting claims and few empirical studies have addressed the key issues relating to the use of site maps to augment WWW navigation. Instead, research has concentrated on the technical development of novel site map tools overlooking the nature of the problem that such tools purport to solve.

This paper critically reviews work done over the past few years on the application of site maps to the World Wide Web. The paper initially analyses web usability problems and proposes a method of classifying site maps. A further classification of goals based on the types of questions users ask whilst interacting with the Web is also described. Finally a 'User Goal to Map Type' matrix is created providing the framework for a subsequent discussion of the suitability of each site map type in supporting different demands placed on users of the World Wide Web.

2. WWW Navigation

2.1 Disorientation

One of the central WWW usability problems relates to the vast amount of information that the Web contains and the limited methods by which a user can access this information. As a consequence of these two factors, users are prone to suffer from disorientation whilst navigating through the WWW (Nielsen, 1990; Rivlin et al, 1994). The symptoms of WWW disorientation are "where users cannot get an overview, cannot find specific information, stumble over the same information again and again, cannot identify new and outdated information, cannot find out how much information there is on a given topic and how much of it has been seen, etc."(Kappe, 1995).

Current WWW navigational tools compound this disorientation problem. Web browsers do not provide the facilities to visualise the inter-relationships between pages preventing users from answering questions such as "Where am I?", "Where can I go from here?" or "Which pages point to this page?" (Bieber et al, 1997). This lack of knowledge of the overall structure of the site results in confusion and cognitive overload when users jump from one location to another in the WWW (Mukherjea & Foley, 1995) or encounter multiple paths to the same or different endpoints (Hedberg & Harper, 1991).

2.2 Cognitive Overhead

A major reason that users feel disoriented is that they must perform several tasks simultaneously as they navigate through a hypertext system (Conklin, 1987; Foss, 1989). The navigational task of planning and executing paths through the hypertext system may be regarded as meta-decision making process, since it is subordinate to the actual task of reading and understanding. These meta-tasks provide cognitive overhead above that of simply reading linear text where the sequence of material has been pre-determined by an author.

These additional cognitive tasks compound the already limited capacity of the human information processing system (Thuring, et al, 1995). Empirical studies (Wright & Lickorish, 1994, Nilsen et al, 1992) that navigational tasks impose an additional cognitive load which can be detrimental to task performance. Careful interface design utilising appropriate cognitive aids can reduce substantially the amount of metal effort required to interact with systems (Preece, 1994). Optimally, systems should minimise the overall memory demands through the use of intuitive interfaces.

3. WWW Site Maps

General hypertext research has raised awareness of the problems of disorientation and cognitive overhead and has subsequently developed a variety of navigational mechanisms, tools and interfaces that can be deployed to assist users. One interface tool that has been developed from research into general hypertext systems is the 'Overview Diagram'. Overview diagrams provide a graphical representation of the system topology and are a common feature in many hypertext implementations. Such diagrams assist the user in the task of navigation by allowing them to generate an appropriate mental model of how the hypertext system is structured (Simpson, 1990). Mental models are cognitive mechanisms that are dynamically created through experience as people interact with others and their environment (Norman, 1988) allowing predictions to be made about events before carrying out actions. Overview diagrams also relieve the overhead on user's short-term memory by providing visual clues to the structure of the system and their relative location within it (Cockburn & Jones, 1996). The use of overview diagrams, better know in Web terms as 'site maps', as a technique of overcoming disorientation and allowing users to obtain a visual overview has been suggested by many researchers (Bieber et al, 1997; Cockburn & Jones, 1996; Mukherjea & Foley, 1995; Shneiderman, 1997; Tauscher & Greenberg, 1996).

4. Classifying Site Maps

There have been a large number of different types and styles of site maps developed since the conception of the WWW each utilising different interface techniques and each addressing different user needs. One method of classify site maps is to examine the representation of links and nodes and base the classification on the extent of connectivity represented. This method of classifying site maps yields four main categories:

4.1 Map Type A: All Nodes & All Links

'All Nodes & All Links' maps (Figure 1) display the complete topology of a web site in a graphical node-link diagram. They are usually automatically generated utilising computational techniques which scan sites noting all nodes and links (Mukherjea et al, 1995). Such methods are relatively primitive and usually produce highly complex structures which are of questionable usability. For example, large maps give rise to the need to use of scroll bars to enable the user to change views of the map causing the user to perform sub-optimally (Beard and Walker II, 1990). Site maps are are also typically too complex for real use, (Nielsen, 1990) even with the addition of filtering tools they are difficult for people to gain an appropriate working mental model within short-term memory limitations. Further problems in relation to size, loss of semantic information and manageability have also been identified (Foss, 1989).

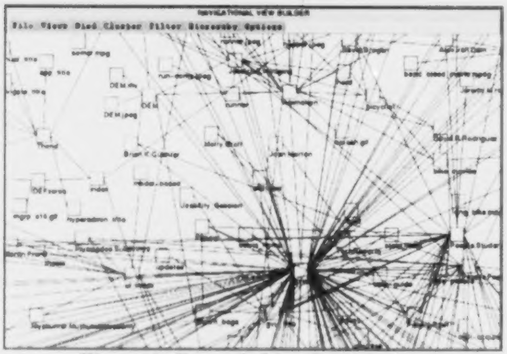
Figure 1: Example Map Type A

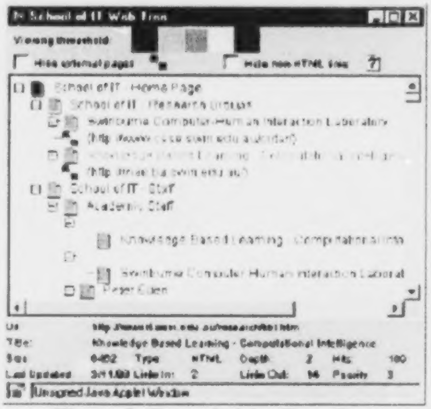
School of IT Web Tree
Viewing threshold
Hide external pages
Hide non HTML files
School of IT - Home Page
School of IT - Research Groups
School of IT - Staff
Academic Staff
Knowledge Based Learning - Computational Inte
Peter Eden
Title:
Knowledge Based Learning - Computational Intelligence
Size
Type
HTML
Depth
Hits
Last Updated
Links In:
Links Out:
Parents
Unsigned Java Applet Window

Figure 2: Example Map Type B

4.2 Map Type B: All Nodes & Partial Links

All Nodes & Partial Links maps (Figure 2) present a simplified abstraction of the full detail by removing 'less important' links. The mapping tool essentially imposes a simpler topology onto the full map hence reducing complexity and thus increasing navigational performance (Parunak, 1989). These types of abstractions generally result in a hierarchical representation where the number of alternatives that must be considered at any one time has been reduced (Norman K., 1991). Research suggests that even in the most random topology, users will tend to impose a hierarchical structure to try to make sense of the structure (NcNamara et al, 1989). Applying a hierarchical representation to the network topology of a hypertext system may result in loss of some information. Not all links can be displayed and some semantic connections between sections of the system will be lost.

4.3 Map Type C: Partial Nodes & Partial Links

Partial Nodes & Partial Links maps (Figure 3) present a true "overview" to the user by removing most of the detail leaving only a high-level representation of the site structure allowing the user to obtain a sense of the extent of the hypertext system (McAleese, 1989). It must be remembered that the purpose of an overview map should be to provide an overview and not a fine grain picture. Topographical maps used for physical navigation usually show an abstracted version of reality in order to convey the high-level conceptual layout of an area rather than a photo-perfect image of everything. Therefore it may be suggested that WWW site maps should only provide a high-level overview of the structure of the site and should not contain detail.

4.4 Map Type D: History Only

Ayers & Stasko (1997) differentiate between an 'Exploratory approach' that involves a pre-search of a site to build a map and a 'Reflective approach' where the map is constructed during a browsing session. This distinguishes between full site maps and history based maps (Figure 4). Full site maps are pre-generated either manually or automatically by the site map designer. History based maps augment the web-browser by building a graphical map as the user moves through the site creating a view of all pages visited in a session. The visual representation matches the user's mental mode of the relationships between the documents thus lessening the cognitive load on the user to recall pages by title.

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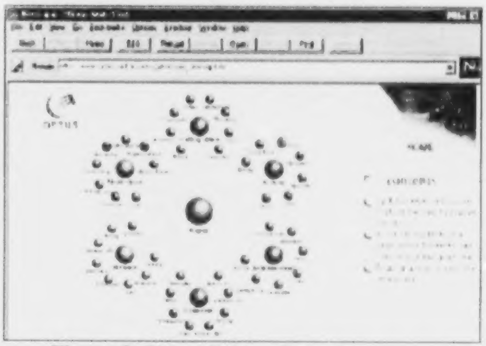

Figure 3: Example Map Type C

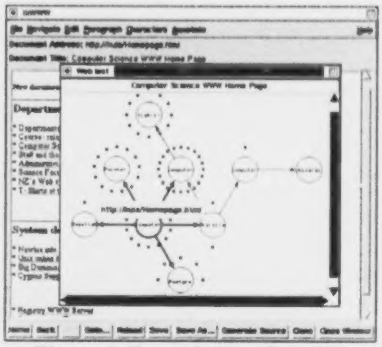

Figure 4: Example Map Type D

5. User Goals

5.1 Information Retrieval

Information retrieval is the identification of units of information within the information space that are relevant to a particular information need. There are two general categories of users with respect to information needs (Duncan & McAlyeese, 1987):

(i) Users who know what they want and are able to express their need in a precise way.

(ii) Users who are unsure of what they want, who think they have a gap or discontinuity in understanding, and who cannot because of a lack of domain expertise express this need formally.

This classification is probably not bipolar, but rather a continuum based on the level of 'goal-directness' the user exhibits.

The type of information need or task is also relevant to the way that users will interact with the information retrieval system. Tasks may be either closed or open. Closed tasks have a discrete answer or set of answers and once achieved will result in closure of the need. Open tasks such broad fact finding or exploration of availability of information on a topic do not have a finite answer and hence will not have a specific point of closure where the information need is satisfied. Shneiderman (1997) extends this classification of tasks to four categories: i. Specific fact finding, ii. Extended fact finding, iii. Open-ended browsing, and iv. Exploration of availability.

There are a variety of methods of classifying the goals of users whilst interacting with hypertext based information retrieval systems such as the World Wide Web. These classifications are typically course grain as the specificity of user's goals varies widely (Canter et al, 1985; McAleese, 1989). One classification method focuses on the decision making process as a user moves through a system. This may be likened to the process of 'wayfinding' as people find their way to a location in the physical world. Wayfinding is defined as "the purposeful, oriented movement during navigation" (Darken, 1996). This process is linked to a series of questions that users constantly ask whilst making their way to their destination: "Where am I?", "Where do I want to go?", "Am I on the right path?", "Am I there yet?" (Bachiochi et al, 1996). In the context of the virtual world of the World Wide Web, further questions are constantly asked: "What does this site contain?", "How large is this site?", "What else is there about ....?", "Where have I come from?", "Where is ....?".

5.3 General Goal Types

Five general goal types may be identified providing a classification that may be divided into two major categories each relating to a particular user question type:

5.3.1 Goal-based

(a) Connections – e.g. "What is related to.....?"

These type of questions attempt to establish what relationships exist between the current node and other nodes. This is an essential element of hypertext where one element of information triggers an association with another element (McAleese, 1988) thus providing incidental learning and the identification of serendipitous connections.

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(b) Search – e.g. "Where is ....?"
This is a focused question where the user has a reasonably well-defined goal. The user therefore may navigate toward a target node by selecting a particular sequence of links. Specific search strategies are usually employed which are heuristic, interactive and data driven (Marchionini, 1995).
(c) Overview – e.g. "What is this site about?" & "What is the extent of this site?"
These types of questions are generally asked by first-time visitors to a web site in order to allow them to determine the suitability of the particular site to their interests.

5.3.2 Positional

(d) History – e.g. "Where have I come from?"
This question is asked by users when they backtrack over previous paths.
(e) Current Location – e.g. "Where am I now?"
A non-specific question which indicates the user is disoriented.

6. Goal-Map Type Matrix

The following matrix (Figure 5) suggests a relationship between the type of site map and the goals of the user. Detailed site maps display all links and are hence allow the user to establish and follow connections between different sections of a web site. Abstracted site maps usually present the map as a hierarchy supporting search strategies. True overviews only display the key nodes and hence allow a user to quickly gain an appreciation of the content and extent of a particular site. History-based maps support the user in the process of backtracking.

	Goal Type			
Map Types	Overview	Search	Connections	History
Detailed			✓	
Abstracted		✓		
Overview	✓			
History				✓

Figure 5: Goal-Map Type Matrix

7. Conclusion

An increasingly large number of WWW sites are employing the use of "site maps" as navigational aids but relatively little is known about the benefits such devices bring to the user. The intention of this review is to provide a sounder basis for future research and development of WWW site maps tools by clarifying existing research and identifying important issues for the future. The paper provides researchers with a classification that may be used to not only categorise new work in relation to existing research but will assist in evaluating new site map designs in terms of suitability for task. The proposed 'User Goal to Map Type' matrix provides an essential reference point for developers of new site map tools allowing them to justify and focus design. This paper also highlights the need for empirical research into the fundamental issues of WWW navigation in order to substantiate the variety of site map designs currently evolving.

References

Ayers, E. Z. Stasko J. T. 1995. Using Graphic History in Browsing the World Wide Web. *Proceedings of the Fourth International World Wide Web Conference*Boston, MA.

Bachiochi, D. Berstene M. Chouinard E. Conlan N. Danchak M. Furey T. Neligon C. Way D. 1997. Usability Studies and Designing Navigational Aids for The World Wide Web. *Proceedings of the Sixth International World Wide Web Conference*Santa Clara, CA.

Beard, D. Walker J. 1990. Navigational Techniques to Improve the Display of Large Two-Dimensional Spaces. *Behaviour & Information Technology* 9, no. 6.

Bieber, M. Vitali F. Ashman H. Balasubramanian V. Oinas-Kukkonen H. 1997. Fourth generation hypermedia: some missing links for the World Wide Web. *Int. J. Human-Computer Studies* 47, no. 1: 31-66.

Canter, D. Powell J. Wishart J. Roderick C. 1986. User navigation in complex database systems. *Behaviour & Information Technology* 5, no. 3: 249-57.

Cockburn, A. Jones S. 1996. Which Way Now? Analysing and Easing Inadequacies in WWW Navigation. *Int. J. Human-Computer Studies* 45, no. 1: 105-29.

Conklin, J. 1987. Hypertext: An Introduction and Survey. *IEEE Computer*, no. 9: 17-40.

Darken, R. P. Siebert J. L. 1996. Wayfinding Strategies and Behaviors in Large Virtual Worlds. *Proceedings of SIGCHI'96*.

Foss, C. L. 1989. Tools for Reading and Browsing Hypertext. *Information Processing and Management* 25, no. 4: 407-18.

Hedberg, J. G. Harper B. 1991. Creating Interface Metaphors for Interactive Multimedia. *Proceedings of the First International Interactive Multimedia Symposium*Perth, W.A..

Hoffman, M. 1996. *Enabling Extremely Rapid Navigation in Your Web Document*, http://www.pdr-is.com/infoaxcs.htm.

Kappe, F., Visualizing the World Wide Web: Putting the User in the Driver's Seat, Panel, *Proceedings of the Fourth International World Wide Web Conference*, Boston, MA.

Kerr, S. T. 1990. Wayfinding in an Electronic Database: The Relative Importancs of Navigational Cues vs Mental Models. *Information Processing and Management* 26, no. 4: 511-23.

Marchionini, G. 1995. *Information Seeking in Electronic Environments*.CUP.

McAleese, R. 1989. Navigation and Browsing in Hypertext. *Hypertext: Theory into Practice*. Editors D. W. Edwards, and L. Hardman, 6-44. Oxford: Intellect Books.

McNamara T.P./Hardy J.K./Hirtle S.C. 1989. Subjective hierarchies in spatial memory. *Journal of Experimental Psychology: Learning, Memory and Cognition* 15: 211-27.

Morville, P. 1996. Mapping Your Site. *Web Review: Http://Www.Webreview.Com/96/09/27/Arch/*.

Mukherjea, S. Foley J. D. 1995. Visualising the World-Wide Web with the Navigational View Builder. *Proceedings of the Third International World Wide Web Conference*Darnstadt, Germany.

Nielsen, J. 1990. The Art of Navigating Through Hypertext. *Communications of the ACM* 33, no. 3: 296-310.

Nilsen, E. Jong H. Olson J. S. Polson P. O. 1992. Method engineering: from data to model to practice. *Proceedings of ACM Conference on Human Factors in Computing Systems*, 313-20N.Y.: ACM.

Norman, D. A. 1988. *The Psychology of Everyday Things*. New York: Basic Books.

Norman, K. L. 1991. *The Psychology of Menu Selection*. N.J.: Ablex Pub.

Parunak, H. V. D. 1989. Hypermedia Topolgies and User Navigation, *Proceedings of Hypertext 89, 43-50*.

Preece, J. (1994), Human Computer Interaction, Addison-Wesley

Rivlin, E. Botafugo R. Sceneiderman B. 1994. Navigating in Hyperspace: Designing a Structure Based Toolbox. *Communications of the ACM* 37, no. 2.

Shneiderman, B. 1997. Designing Information-Abundant Web Sites: Issues and Recommendations. *Int. J. Human-Computer Studies* 47, no. 1: 5-30.

Shubin, H. 1997. *Navigation in Web Applications* , Interaction Design, http://www.user.com/webapps/webapps.zip.

Simpson, A. 1990. Lost in Hyperspace: How can Designers Help? *Intelligent Tutoring Media* 1, no. 1: 31-40.

Sullivan, S. 1996. *Re-Examining Imagemaps*, http://www.panto.org/atw/35251.html.

Tauscher, L. Greenberg S. 1996. Design Guidelines for Effective WWW History Mechanisms. *Proceedings of the Second Conference on Human Factors and The Web : Designing for the Web - Empirical Studies*Redmond, WA: Microsoft Corp.

Thuring, M. Hannemann J. Haake J. M. 1995. Hypermedia and Cognition: Designing for Comprehension. *Communications of the ACM* 38, no. 8: 57-69.

Wright, P. Lickorish A. 1994. Menus and Memory Load: Navigation Strategies in Interactive Search Tasks. *Int. J. Human-Computer Studies*, no. 40: 965-1008.

Registering Web-Based Conferencing With Structured XML Documents

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Abstract: The aim of the work reported in this paper is to provide an environment where users exploit the Web as a platform to communicate using simple conferencing tools at the same time that have the memory of that communication registered as structured hyperdocuments for later retrieval an reuse. We present DocConf, an extensible tool to support Web-based conferencing that provides the registering of the communication occurring in a conferencing session as an XML-structured hyperdocument, as well as relies on such hyperdocument to present all the previous activities of a session to newcomer users.

1. Introduction

Douglas Engelbart, one of the visionaries of computer science and technology, was among the first to discuss the advantages of exploiting structured hyperdocuments to provide for interoperability between CSCW tools. His proposal, the Open Hyperdocument System (OHS), would provide standards and facilities to the creation, storage, retrieval and interchange of knowledge by using hyperdocuments [Engelbart 90]. Elgerbart's recent view is that the World Wide Web (Web) can expand to provide a platform for the goal of augmenting communities of collaborating knowledge workers. His suggestion is that the Web should grow towards to become the OHS, which would demand, among others, integrated object oriented applications, explicitly structured documents and view control of form, sequence and content [Engelbart 95, 98].

Commenting on the benefits resulting from combining the technologies of hypermedia and computer supported collaborative work in the early 90's, Streitz suggested that such a combination would result in multi-user distributed hypermedia systems at the same time that CSCW tools could benefit from the use of structured hyperdocuments. In the same context, Ishii specifically suggested the use of structured documents to register the memory of the group in CSCW applications [Streitz 91].

There are many efforts being made in terms of allowing for the specification of the structure of the documents in a standardized way, a case in point is the XML specification recommended by the World Wide Web Consortium (W3C), as discussed in Session 4.

Moreover, recent work has been done in order to exploit the Internet as an environment for synchronous communication that supports collaborative work. An important reference is Habanero, a software suite designed to facilitate the development and integration of collaborative Internet applications [Chabert 98].

We have been working in the development of an extensible software suite that provides infrastructure for synchronous and asynchronous collaborative work over the Internet in general, and the Web in particular. In this project, we investigate flexible ways to support the automatic generation, storage, retrieval and presentation of the information generated in a collaborative working session. In this context we have build DocConf, an extensible tool to support Web-based conferencing that provides the registering of the communication occurring in a conferencing session as an XML-structured hyperdocument, as well as relies on such hyperdocument to present all the previous activities of a session to newcomer users.

The aim of the work reported here is to provide an environment where users exploit the Web as a platform to communicate using simple conferencing tools at the same time that have the memory of that communication registered as structured hyperdocuments for later retrieval an reuse. An important requirement is that the document generated be structured according to an open recommendation to allow information interchange and manipulation.

The basic conferencing services provided include a chat tool for exchanging typed messages, a common whiteboard and support to synchronous voting. The environment is easily extensible to facilitate the integration of tools related to other media (such as audio and video) or tasks (e.g. shared Web browser).

The remaining sections of this paper are organized as follows. The next section states the requirements defined for DocConf, as well as presents information on its current stage of implementation. The following section details aspects of the architecture of communication in DocConf. Next, the advantages of using XML to formalize the structure of the generated documents are listed, preceding a section that details the XML specification for a hyperdocument of a DocConf session. Following, a section gives an overview of typical steps taken by a user when entering a session, relating them with the generation of the underlying hyperdocument. Sections on related work and final remarks conclude the paper.

2. Requirements and Current Stage

This section lists the functional requirements specified to DocConf, as well as describes how the functionality is delivered, if implemented, or the current stage of its implementation, if under development.

Support to synchronous sessions. A session begins when created by the first participant (the owner) and ends when the last participant leaves: the server module of DocConf keeps track of logins and all other requests.

Registering the exchanged communication in a structured hyperdocument. XML was chosen as the specification language given the advantages discussed in [Advantages of Using XML], and a specification named DocConf DTD was defined to support a DocConf session, as shown in [The DocConf Specification]. The DocConf server registers all messages exchanged among the clients as the corresponding XML elements.

Support communication by a chat tool, a common whiteboard and a voting tool. Three tools were implemented and can be loaded as part of a session or not, depending on the configuration given when the creation of the session. However, a tool not requested at the time of the creation of a session can be loaded at any time during the session.

Presence reporting. DocConf may be set to indicate all the users present in any session at a given time. This type of information is important to support small and large groups [Benford 97].

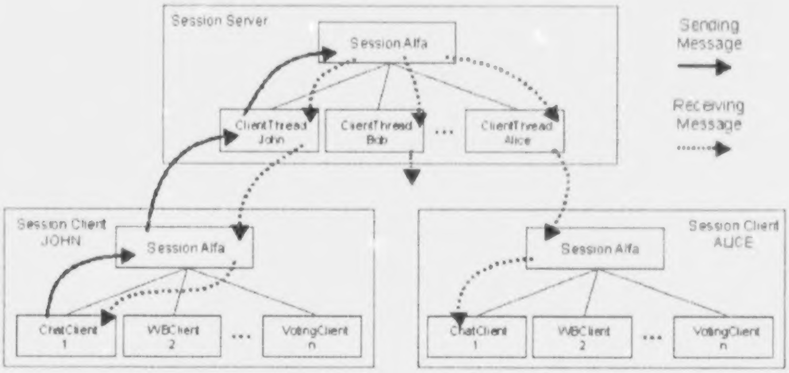
Allow late login: when a user enters an open session, the conferencing tools (chat, whiteboard and vote) show the information previously discussed: the client module of DocConf requests from the server the information XML document corresponding to the session.

Support to asynchronous sessions. Support in DocConf to asynchronous sessions is currently under development, and exploits the component-based architecture of the current implementation.

3. Architecture of Communication

DocConf is being implemented in Java: Swing is used for the implementation of the graphical user interface, and sockets TCP/IP are used to provide fast and reliable client/server communication.

DocConf uses an architecture of communication based on components, which correspond to the rectangles illustrated in [Fig.1]. A "Session Server" module has one component for each session it controls ("Session Alfa" in "Session Server" of [Fig.1]), which in turn has one component has one component to each user logged in the session ("ClientThread" in the "Session Server" of [Fig.1]).



The flow of information between DocConf client and server modules

Similarly, each "Session Client" module has one component for the session it corresponds to ("Session Alfa" in the "Session Client" of [Fig.1]), as well as one component for each tool used in the session (e.g.: "VotingClient").

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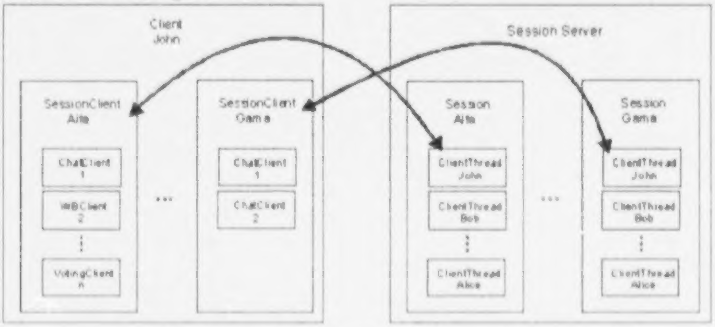
The functionalities of DocConf are implemented using components, each component having two objects: interface and message. Messages are objects generated by the interface and are send to/received from the server. A server forwards the information received without processing it: specific processing is done on the interfaces in the client modules (as indicated in the flow of messages in [Fig.1]).

The interface is responsible by interacting with the user, communicating messages and implementing the functionality of the tool (e.g.: drawing in the whiteboard) with the server. Messages correspond to all data exchanged among modules, including control information (e.g.: user login in) and content (e.g.: user identification).

A user can participate in more than one session simultaneously, and several types of objects manage the underlying communication. As illustrated in [Fig.2], a user runs one instance of the object "Client", which owns one object "SessionClient" for each session the user is in. Similarly, the object "Session Server" owns one object "Session" for each session managed. A "Session" object creates a "ThreadClient" object for each user (a "SessionClient" object) communicating in that session.



Class hierarchy for DocConf client and server modules

4. Advantages of Using XML

Referring to the work of the Word Wide Web Consortium, Rada et al. state that standards are the body and soul of the Web [Rada 98]. The World Wide Web Consortium (W3C) has been investing many efforts in order to guarantee the growth of the Web in an open and standardized way, for instance by defining recommendations regulating the formalization of the structure of documents and their presentation format. Specifically, the Extensible Markup Language (XML) helps domain application designers to provide a logical structure for the supported documents [XML 98], while Cascade Style Sheets (CSS) and Extensible Style Sheet Language (XSL) help those authors to standardize the presentation format and reuse of their document [CSS 96] [XSL 99].

Although XML aims at supporting intra-domain interoperability, there is still the problem of providing distinct domains a way to cross communicate. To solve the latter, the W3C has just released the specification of the Resource Description Framework (RDF), a foundation for processing metadata and make information exchangeable across application domains on the Web.

The structuring and storage of the information produced during a session using a standard markup language such as XML bring the advantages described below, some of them common to any XML based-application as discussed in [Bosak 98] [Connoly 98] [Glushko 98]:

Interoperability among applications. It is not necessary for applications, mainly third party ones, to know details of a particular database structure, which could be used as an alternative to XML for internal storage purposes.

Distributed processing. Besides third party authorized applications, which may require access to the XML document produced during a session, all the clients, representing the participants of the session, are continuously receiving from the server the events of the session. Hence they are able to keep updated their local version of the XML document, which reflects the state of the session until the considered moment, and to promote local processing in order to recover and manipulate particular information.

Customized view. As a result of the flexibility given by the XML, the clients can customize the presentation of the partial document during the session, or of its totality, afterwards. That is quite handy to help and support their participation in the cooperative work and for posterior analysis of the session. As an example, a participant of a meeting might want to keep in her screen, during the session, a particular view referring to her interventions.

Semantic attribution. For the more structured or formal sessions, even for the asynchronous ones, or for those related to a specific area, participants may find useful to contribute with marked up contents in order to allow

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semantic attribution to the information and facilitate its automatic processing. In such a situation, structuring all the session as a XML document is likely to be a good and homogeneous approach.

Independent searching. Taking a chunk of information as a XML document allows any application to browse freely the document and to extract the information needed.

Reduced traffic. The possibility of browsing the document locally, at the client side, may be more efficient, in terms of network traffic, for applications that would instead require several queries to a remote database.

Fast searching. Another advantage of browsing the document locally is speeding searching procedures.

5. The DocConf Specification

The DocConf Document Type Definition (DTD) shown in [Fig.3] is the specification for the documents generated in the DocConf sessions. Each document is composed by the elements <head> and <body>. The <head> element stores information relative to the creation of a session (<name> and <moderator>). The <body> element contains control and content information corresponding to the communication that occurs among the users, and as such contain the elements <login>, <logout>, <chat>, <whiteboard> and <vote>.

Within the <body> element, many elements have other control information specified in terms of attributes of the corresponding element, such as identification information <compid> or a timestamp <date>.

The element <cstart> stores information about the initialization of a new component. It may have some <param> elements which hold extra information like component layout or initializing options.

The <chat> element contains information manipulated by the chat tool, and has elements <message> and <from> for each message exchanged. The element <whiteboard>, in turn, keeps information manipulated by the whiteboard tool, and has elements such as <shape> for empty shape, <filledshape> for filled shape, <text> for typed text, and <polyline> for polygons. Among the attributes of these elements are <type>, for specifying whether a shape is a circle for example, <coords> for specifying the position of the element on the whiteboard, <foreground> for specifying the color of the object, and <background> for specifying the filling of a filled shape object. The element <vote> keeps the votes for voting situations; the voting options are defined in the <cstart> element.

```
<!ELEMENT session    (head,body)        >
<!ATTLIST session         date   CDATA #required      >
<!ELEMENT head      (id,moderator)     >
<!ELEMENT id       (#PCDATA)*        >
<!ELEMENT moderator  (#PCDATA)*         >
<!ELEMENT body      (login | chat | whiteboard | voting |
vote | logout)*    >
<!ELEMENT login     (#PCDATA)*        >
<!ATTLIST login        date      CDATA #required >
<!ELEMENT logout    (#PCDATA)*        >
<!ATTLIST logout        date      CDATA #required >
```

```
<!-- Chat tool elements              -->
<!ELEMENT chat      (from,message)     >
<!ELEMENT from      (#PCDATA)*         >
<!ELEMENT message    (#PCDATA)*         >
<!ATTLIST chat compid      CDATA #required date
CDATA #required >
...
<!-- Voting tool elements            -->
<!ELEMENT vote      (#PCDATA)*         >
...
```

Portion of the DocConf Document Type Specification

6. DocConf Interaction and Document Creation

The typical steps taken by a user to participate in a session are presented to illustrate how the associated structured document is created. In each case, the elements for the DTD involved in the registering of the associated information are indicated using the name of the element within angular brackets, as in <moderator>.

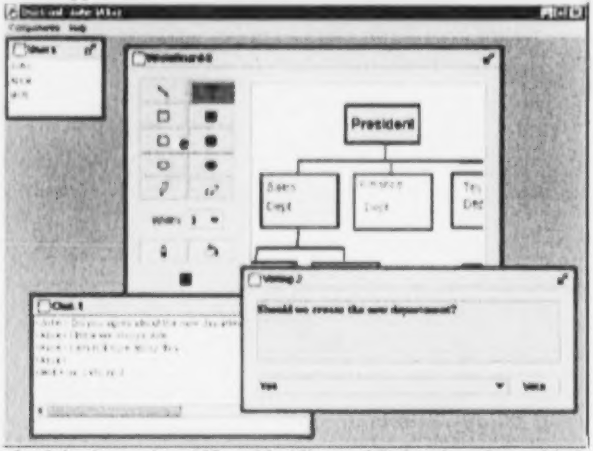
Welcome window: In the Welcome window, users provide their identification (name and password) as well as of the client and servers machines. New users give registering information in additional window.

Access window: The Access window presents options relative to Session, Users and Tools. The Session options are Create, Enter and Close. When creating a session, the user specifies whether there is a moderator (<moderator>) and which tools are to active (<chat>, <whiteboard> and <vote>). When entering a session, the DocConf client generates an application corresponding to the specification for that session, and sends information to the server that the user has logged (<login> and <date>). When a user is the only one in a session, the option for closing session is activated and, if selected, this information is sent to the server, that stores the associated document.

DocConf window: The DocConf window has a child window for each toll selected to the corresponding session, as illustrated in [Fig.4]. The users can use the chat tool send a message to all participants (<chat>, <from> and <message>), draw or write on the whiteboard (<whiteboard>, <text>, <shape>, <polyline>), or have a voting session

(<vote>). A portion of the DocConf document generated by the session illustrated in [Fig.4] is shown in [Fig.5].

It is important to observe, at this point, how important is the provision of a DTD for the design and implementation of a suite such as DocConf. As suggested by [Pimentel 98], such a provision can be used to guide the development of the associated application.



DocConf Client for John in session Alfa, with Alice and Bob using chat, whiteboard, and voting tools.

```
<SESSION DATE="20/02/99 18:03:25">
<HEAD>
  <ID>Alfa</ID>
  <MODERATOR>John</MODERATOR>
</HEAD>
<BODY>
<LOGIN DATE="20/02/99 18:03:36">John</LOGIN>
<LOGIN DATE="20/02/99 18:04:41">Alice</LOGIN>
<LOGIN DATE="20/02/99 18:04:45">Bob</LOGIN>
...
<WHITEBOARD COMPID="0" DATE="20/02/99 18:05:18">
  <FILLEDSHAPE        TYPE="RECTANGLE"        COORDS="86,121"
DIMENSIONS="93,45" THICKNESS="3"
          FOREGROUND="0,0,0" BACKGROUND="255,204,204"/>
</WHITEBOARD>
<WHITEBOARD COMPID="0" DATE="20/02/99 18:05:27">
  <TEXT              COORDS="8,145"              FONTSIZE="14"
FOREGROUND="0,0,0">Sales Dept.</TEXT>
</WHITEBOARD>
<WHITEBOARD COMPID="0" DATE="20/02/99 18:06:02">
  <SHAPE   TYPE="LINE"   COORDS="34,99"   DIMENSIONS="247,1"
THICKNESS="3" FOREGROUND="0.0.0"/>
</WHITEBOARD>
...
<CHAT COMPID="1" DATE="20/02/99 18:07:08">
  <FROM>John</FROM>
  <MESSAGE>Do you agree about the new department?</MESSAGE>
</CHAT>
<CHAT COMPID="1" DATE="20/02/99 18:07:25">
  <FROM>Alice</FROM>
  <MESSAGE>I think we shoud vote</MESSAGE>
</CHAT>
...
<CHAT COMPID="1" DATE="20/02/99 18:07:08">
  <FROM>John</FROM>
  <MESSAGE>Do you agree about the new department?</MESSAGE>
</CHAT>
<CHAT COMPID="1" DATE="20/02/99 18:07:25">
  <FROM>Alice</FROM>
  <MESSAGE>I think we shoud vote</MESSAGE>
</CHAT>
...<VOTING COMPID="2" DATE="20/02/99 18:08:20" ID="v2">
  <SUBJECT>Should we create the new department?</SUBJECT>
  <OPTION>yes</OPTION>
  <OPTION>no</OPTION>
</VOTING>
<VOTE         COMPID="2"         DATE="20/02/99         18:08:30"
IDREF="v2">yes</VOTE>
<VOTE         COMPID="2"         DATE="20/02/99         18:08:37"
IDREF="v2">no</VOTE>
<VOTE         COMPID="2"         DATE="20/02/99         18:08:41"
IDREF="v2">yes</VOTE>
<CHAT COMPID="3" DATE="20/02/99 18:10:08">
  <FROM>Bob</FROM>
  <MESSAGE>Acording to the votes, the new department will be
created.</MESSAGE>
</CHAT>
...
<LOGOUT DATE="20/02/99 18:12:16">Bob</LOGOUT>
<LOGOUT DATE="20/02/99 18:12:47">Alice</LOGOUT>
<LOGOUT DATE="20/02/99 18:13:19">John</LOGOUT>
</BODY>
</SESSION>
```

Portion of XML document generated for the session presented in [Fig.4]

7. Related Work

Developed by the National Center for Supercomputing Applications (NCSA), University of Illinois, Habanero provides a platform for collaboration over the Internet, specially aimed at the educational and science domains. Habanero is implemented in Java, and provides an API with a set of objects that can be used by the developer as the underlying communication mechanism to the target application. The proposal is to allow the programmer to develop a collaborative application by altering an existing single-user application or by developing a new one from scratch.

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Habanero provides arbitrators for applications that need locks or turn taking and, at this point, Habanero is being extended to allow asynchronous participants. DocConf shares many requirements with Habanero, in particular the aim of allowing easy extensibility and reuse of existing tools.

Prospero is a toolkit for developing groupware applications that focuses on flexibility. In this case, flexibility is understood as the range of applications that can be developed with a toolkit, which must be flexible enough to support the many ways of interactions that may occur between people [Dourish 98]. To manage the flexibility, Prospero proposes a new architectural approach - Open Implementation - where the programmer not only specifies how the application will use the toolkit infrastructure, but also can examine and modify this infrastructure implementation. In this way, the toolkit developer does not have to preview all the future uses of his system and the programmer can adapt the application to its best interest. DocConf is not implemented in such an open architecture approach; however, the component model on which it has been build provides some of the related benefits: supporting extensibility being the most important in the context of this project.

When compared to those and other work reported in the literature, DocConf is the only suite to be built upon an approach for supporting structured documents.

8. Final Remarks

In a complementary view to Engelbart's, Gaines remarks that the growth of the Web, and the evolution of their underlying technologies, may contribute to the foundations of the knowledge science [Gaines 96]: there is no doubt that facilitating human-to-human communication in such an environment may bring contributions.

We presented DocConf, an environment where users can exploit the Web as a platform to communicate using simple conferencing tools such as a shared whiteboard, a chat tool and a synchronous voting tool. A unique feature of DocConf is that the memory of a session is registered as a structured hyperdocument for later retrieval and reuse. DocConf has been built in such an approach that allows for easy extensibility and reuse of existing tools. DocConf have been successful integrated as the communication tool in a Computer Supported Collaborative Learning (CSCL) project [Macedo 99]. Future tasks include full provision for asynchronous sessions and support to other media.

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References

[Bosak 98] Bosak, J. XML, Java, and the future of the Web. Sun Microsystems (c. 1 Oct 98) http://sunsite.unc.edu/pub/sun-info/standards/xml/why/xmlapps.htm (1997).

[Benford 97] Benford, S., Greenhalgh, C. & Lloyd, D. (1997). Crowded Collaborative Virtual Environments. *CHI'97 – Conference on Human Factors in Computing Systems, 1997.* ACM. 59-66.

[Chabert 98] Chabert, A., Grossman, E., Jackson, L. S., Pietrowiz S. R. & Seguin, C. (1998). Java object-sharing in Habanero. *Communications of the ACM*, 41 (6), 69-76.

[Connolly 98] Dan Connolly. The XML Revolution http://helix.nature.com/webmatters/xml.html

[CSS 96] W3C (1996) Cascading Style Sheets, level 1 (CSS1). http://www.w3.org/TR/REC-CSS1/

[Dourish 98] Dourish, P. (1998). Using Metalevel Techniques in A Flexible Toolkit For CSCW Applications. *ACM Trans. Computer-Human Interaction*, 5 (2), 109-155.

[Engelbart 90] Engelbart, D.C. (1990). Knowledge Domain Interoperability and an Open Hyperdocument System. *CSCW'90 – Conference on Computer Supported Cooperative Work, 1990.* ACM. 143-156.

[Engelbart 95] Engelbart, D.C. (1995). Toward Augmenting the Human Intellect and Bosting our Collective IQ. *Communications of the ACM*, 38 (8), 30-33.

[Engelbart 98] Engelbart, D.C. (1998). Augment, Bootstrap Communities, the Web: What Next? *ACM CHI' 1998.* 15-16.

[Glushko 98] Glushko, R.J., (1998) The XML Revolution. Proc. *WebNet'98*. AACE. 342-344.

[Gaines 96] Gaines, B.R., (1996). Convergence to the Information Superhighway. *WebNet'96*. AACE.

[Macedo 99] Macedo, A.A. ; Pimentel, M.G.P.; Fortes, R.P.M. StudyConf: Infra-Estrutura de Suporte ao Aprendizado Cooperativo na WWW. Revista Brasileira de Informática na Educação (RBIE), September. 1999.

[Pimentel 98] Pimentel, M.G., Santos, J. & Fortes, R. (1998). Tools for Authoring and Presenting Structured Teaching Material in the WWW. *WebNet'98*. AACE. 194-199.

[Rada 98] Rada, R., Cargill C. & Klensin, J. (1998). Consensus and the Web. *CACM*. 41 (7), 17-22.

[Streitz 91] Streitz, N. (1991) The Role of Hypertext for CSCW Applications. *Hypertext'91*. ACM. 369-375.

[XML 97] W3C (1997). The Extensible Markup: XML 1.0. http://www.w3.org/XML/

[XSL 99] W3C (1999). The Extensible Stylesheet Language (XSL) Specification. http://www.w3.org/TR/WD-xsl/

JavaBeans, Java, Java Servlets and CORBA Revolutionizing Web-Based Enterprise Application Development

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Abstract: World-Wide Web has provided organizations with an opportunity for competitive advantages. Consequently, there is a fast growing demand for rapid and cost-effective development of Web-based enterprise applications. This has motivated the use of component-based enterprise software development (CBESD). CBESD has the potential to reduce significantly time-to-market and development cost of software systems, and enhance maintainability, reliability and overall quality of software. In this paper, we present a new CBESD approach that integrates JavaBeans, Java, Java Servlets and CORBA. We also describe one of our R&D projects in which we have developed a three-tier Web-based enterprise application using this approach. In addition, we discuss the lessons learned from the project and future plans. The background information required for understanding the issues and technologies involved is covered in the paper.

Keywords: Web-based enterprise applications, component-based enterprise software development, three-tier architectures, CORBA, JavaBeans, Java Servlets, Java, JDBC.

1. Introduction

The Internet and the Web have provided all organizations with an exceptional opportunity for competitive advantages. This has resulted in a fast growing demand for rapid and cost-effective development of Web-based enterprise applications—a major challenge! Traditional software development approach is not sufficient. The rapidly emerging trend is component-based enterprise software development (CBESD).

The focus of this paper is on a new CBESD approach that integrates JavaBeans, Java, Java Servlets and Common Object Request Broker Architecture (CORBA) for Web-based enterprise application development. Java and the Enterprise Java APIs provide the glue for holding legacy systems and Database Management Systems (DBMS) servers together with the next generation of Web-enabled, multi-tier distributed systems that are written in the Java and exploit component technology and techniques [Pour 1999c].

The paper is organized as follows. Section 2 provides an overview of CBESD. Section 3 reviews Web-based application architectures. Section 4 describes major CSESD approaches to developing Web-based enterprise application. Section 5 provides an overview and evaluation of the key technologies. Section 6 presents the new CBESD approach and our R&D project using the approach. Section 7 discusses the lessons learned and future plans.

2. Component-Based Enterprise Software Development

Component-based enterprise software development (CBESD) is based on the selection and integration of a set of pre-engineered and pretested reusable software components within appropriate software architectures [Pour 1999b]. CBESD delivers the promise of large-scale software reuse by promoting the use of reusable components, which are developed by commercial software vendors or in-house developers, as the building blocks of a new software system [Pour 1998c]. CBESD has the potential to: (1) reduce significantly the cost and time-to-market of software systems allowing the systems to be built by assembling a set of reusable components rather than from scratch, (2) enhance the reliability of software systems because each reusable component has gone through several reviews and inspections in the course of its original development and previous usages, (3) improve the maintainability and flexibility of software by allowing new components to replace old ones, and (4) enhance the quality of enterprise application by allowing application-domain experts to develop components, and the software engineers who are specialized in component-based software development to assemble the components and build software systems [Pour 1999c, 1999a].

3. Multi-Tier Architectures for Web-Based Enterprise Applications

The architecture of a software system defines that system in terms of computational components and interactions among those components [Shaw 1996]. Web-based enterprise applications consist of three groups of components: presentation, application logic and data. Presentation components are primarily used for interaction with users. Application logic components perform calculations and determine the flow of the application. Data components manage information that should persist across sessions, planned shutdowns, and systems failures. The idea of using a distinct unit for each component group has motivated multi-tier architectures for Web-based enterprise applications. The components interact through client-server protocols and database-accessing protocols.

In two-tier client/server architectures, presentation and application logic components run together on the client side and data components on the server side. Application components read data from the server, perform application logic and send data back to the server. Two-tier applications usually work fine in departmental-scale applications with modest numbers of users (under 100), a single database, and secure and fast networking. Two-tier architectures fall short for a large number of users and databases, and non-secure network environments because databases must maintain connections to each active client, and connections consume machine resources. In addition, the security model does not work well outside of trusted LAN environments.

In 3-tier architectures, each component group (i.e. presentation, application logic and data) forms a distinct unit. Presentation components manage user interaction and make requests for application services by calling the application logic components in the middle-tier. The middle layer manages the connections to back-end servers as well as the client applications that rely on multiple heterogeneous server connections. The middle tier performs business logic and makes requests to data components in databases and other resources using their native interfaces (e.g. SQL for relational databases). Additionally, the middle layer handles services such as security, authentication, and client software distribution. Using three-tier architectures, the salability, reusability, security and manageability of applications can be enhanced significantly. Load balancing can also be improved.

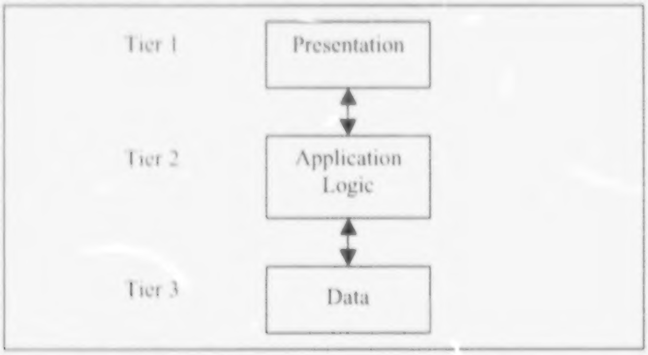

Figure 1: Three-Tier Client/Server Application

It is difficult to reuse and maintain application logic components in two-tier architectures because those components are tightly bound to presentation components. In addition, a user of a two-tier system can only access one database system at a time. Access to other database systems and back-end servers, or mainframe applications must be done via gateways, which create a number of new issues [Xu 1998]. Furthermore, due to lock contention the scalability of two-tier applications is good up to a point and degrades quickly from that point on. Moreover, lock resolution is independent of the server's speed. Therefore, even installing more powerful database servers does not provide significantly greater performance [Liu 1997].

Three-tier architectures are often called server-centric because they allow application components to run on middle-tier servers independent of presentation interface and database implementation. Three-tier architectures are suitable for Web-based enterprise applications due to the following major benefits: (1) system administrators can replicate application components and run them on different machines simultaneously, enhancing the software availability, scalability and performance; (2) application components can share database connections, improving software performance by lowering the number of total sessions that a database server must support; (3) providing access to other resources through native protocols and application interfaces rather than data gateways, improving performance and allowing application owners to control the access to their data,; and (4) allowing developers to make the most of reusable application components for software development and maintenance.

4. CBESD Approaches to Web-Based Enterprise Application Development

Web-based enterprise applications should be able to cross the boundaries of different hardware platforms, different network protocols, different operating systems, and different programming languages. Development of such applications is challenging. The best approach is to integrate Web with distributed objects. The backbone of distributed object-oriented systems is Object Request Broker (ORB), which provides location transparent communications between clients and servers. In three-tier Web-based enterprise applications, Web browsers (Web clients) operate in tier 1, ORBs (Web servers) in tier 2, and DBMS servers and legacy applications in tier 3. There are two key trends to Web-based application development: (1) integration of Java-based technologies and CORBA, and (2) ActiveX and Distributed Component Object Model (DCOM) [Pour 1998a].

5. Overview and Evaluation of Key Technologies

5.1 Java

Java introduces a new model for developing Web-based applications. The explosion of the Web and the need for a solid way to bring its interactivity created the perfect climate for an innovative technology like Java [Morrison 1997]. The mission statement of Java is "Write once and run anywhere". Java offers an elegant and efficient solution to the portability and security problems through Java bytecodes. A Java program is an applet or an application. A Java application runs under the operating system of the computer while Java applets can run inside Web browsers. Java compiler located on the server side compiles Java programs into platform-independent bytecodes. Bytecodes can be downloaded on the client side, and then executed by the Java interpreter. Compiled bytecodes can run on any system supporting Java Virtual Machine (VM); making Java codes portable. In addition, the use of Java bytecodes and the concept of trusted and untrusted Java applets are the key to higher level of Java security.

5.2 JavaBeans

JavaBeans--the Java-based component technology--is used to develop new software systems more rapidly and economically [Pour 1998a]. The mission statement of JavaBeans is "Write once, run anywhere, reuse everywhere." Beans are platform-independent and reusable components (i.e. beans can be created, reused, modified, and assembled into new feature-rich applications using visual builder tools).

5.3 JavaBeans versus ActiveX

ActiveX is the competing technology to JavaBeans. Both technologies are designed for the Web. They have major differences. JavaBeans is platform-independent and language-dependent while ActiveX is Windows platform-dependent and language-independent. The Internet market share of Java and JavaBeans has been significantly expanded due to their platform independency. Furthermore, language-dependency of JavaBeans does not seem to be a problem because Java can run on any platform with Java VM (practically all platforms).

ActiveX relies only on the digital signature verification method to provide security while JavaBeans uses sandboxing and trusted servers in addition to digital signature verification, resulting in higher level of security for Java codes. ActiveX has been roundly criticized by computer security professionals since its approach to security is seen as lacking [McGraw 1999]. Hence, JavaBeans leads ActiveX in terms of security and portability. However, ActiveX leads JavaBeans in its existing code base due to its underlying OCX technology that is widely used by the Windows software community. This may change over the next few years as JavaBeans takes off.

5.4 Java Database Connectivity (JDBC)

JDBC is the Java wrapper for SQL. It provides portable and cross-platform database access for Java programs. It eliminates the need for a gateway program, as it handles connectivity to relational databases, fetching query results, committing or rolling back transactions, and converting SQL types to and from Java program variables. JDBC consists JDBC API and JDBC manager driver API. The JDBC API sends JDBC manager driver API various SQL statements. The JDBC manager driver communicates with various third parties' drivers that are connected to database, and returns the result of query to the user, or performs the action specified by the query.

5.5 Java Servlets

Java Servlet Development Kit (JSLK) was shipped with Java Web Server in mid-1997. Many corporate developers use servlets for a variety of purposes over Intranets, extranets and the Internet. Servlets are small pieces of Java code that can service HTTP requests and generate HTML dynamically. Servlets also extend Java-enabled servers. They combine Java strengths on the server as a portable, platform-independent and network-centric language with the accessibility of HTML clients to deliver database applications that are accessible to any client running a browser. Java servlets have lower deployment and maintenance cost.

Servlets are often used in the middle tier of enterprise networks so they can interact with relational databases via JDBC for storing and accessing user account and merchandise information [Bergsten 1998]. Servlets can keep data persistent between requests. A pool of database connections can be shared by multiple requests, and frequently requested information can be cached. Threading and persistence makes it much easier to develop high performance solutions [Bergsten 1998].

Unlike Java applets, servlets are faceless objects (without graphics or a GUI component), and they can write to files and open sockets very quickly because they are invoked as threads in a demon process. Servlets are to the server-side what applets are to the client-side. Like CGI scripts, servlets are executed on the server. CGI creates a new process for each request while servlets handle requests in the same process through separate threads. Hence, servlet-based applications avoid overhead processing. Additionally, servlets address such problems as non-extensible scripting solutions, platform-specific APIs, and incomplete interfaces (associated with server-side programming). Servlets and CGI have similar functionality. However, servlets are faster, cleaner, and easier to use.

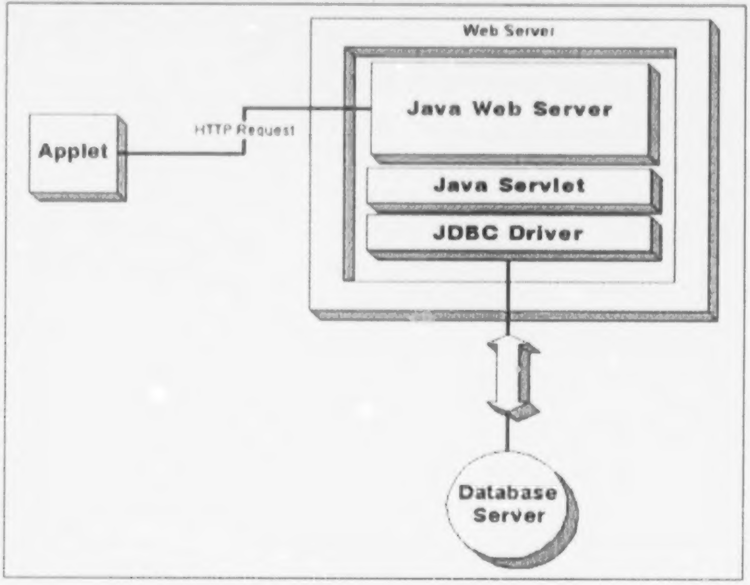

Figure 2: Servlets Application Architecture

5.6 Common Object Request Broker Architecture (CORBA)

CORBA is a set of specifications that provides a standard architecture and communication protocols for interoperability between objects in heterogeneous distributed environments. CORBA was introduced by the Object Management Group (OMG)--the largest industry consortium. CORBA has taken a stronghold in the computer industry, primarily because it is a standard architecture that provides common interfaces and description for objects [Pope 1998]. A growing number of business developers are turning to CORBA object middleware to bring enterprise scalability to their Java applications [Radding 1999]. CORBA has two major components: Object Request Broker (ORB) and Interface Definition Language (IDL). ORB manages location transparent communications between clients and servers. CORBA IDL is a declarative language for defining interfaces of components to become recognizable by CORBA-compliant ORBs. More information on CORBA can be found in [Pour 1994] [Orfali 1997] [Pope 1998].

5.7 CORBA versus DCOM

Distributed Component Object Model (DCOM), like CORBA, is language-independent and has its own Object Description Language (ODL). Compared to CORBA, DCOM has several major shortcomings including being Window-platform-dependent and controlled by one company—Microsoft. This greatly reduces the options of tools and features for DCOM, and significantly limits the use of legacy codes and the scalability of DCOM applications. Furthermore, the messaging and transactions that were provided by CORBA a few years ago are now being considered in DCOM. However, DCOM is integrated with other Microsoft products, which makes it free and attractive to some users.

5.8 CORBA IIOP versus RMI

Remote Method Invocation (RMI) allows a Java client to instantiate objects that may be located on a remote server that is also written in Java. RMI can be used only for communication between Java objects. CORBA has no such restriction. CORBA also offers a set of object services, but RMI does not. Furthermore, RMI does not include any object activation policies such as those used by CORBA-based ORBs. Additionally, server objects written in Java using RMI may suffer from poor performance due to limitations inherent in the Java VM. Java/CORBA-based servers perform better than Java/RMI-based servers do. While RMI is a viable option for smaller-scale Java applications, CORBA is a useful alternative for cross-platform applications. Additionally, CORBA IIOP has a wider acceptance. Sun has also publicly stated its long-term goal to allow RMI objects to communicate via IIOP.

5.9 Servlets versus CORBA/IIOP

Servlets, CGI and sockets, each provides a primitive form of middleware in the client/server architecture, which makes creating own command formats for marshaling and unmarshaling the programmer's responsibility. Servlets can be implemented as CORBA or RMI objects. Servlets interact through a generic API. They lack some of the features expected from a scalable server-side component infrastructure. For example, servlets do not support transactions that are now a standard feature of the CORBA and Microsoft Transaction Service (MTS) server-side component models. Furthermore, servlets do not support a dynamic deactivation mechanism [Orfali 1998].

5.10 Interoperability

The technologies covered in the paper are on their way to become more powerful. This has motivated development of the following bridges that provide interoperability between those technologies: (1) COM/CORBA bridge by Iona, (2) JavaBeans/ActiveX bridge by JavaSoft, and (3) JDBC-ODBC bridge by JavaSoft [Pour 1998a].

6. Our R&D Project

We have adopted the CBESD approach that integrates JavaBeans, Java, Java servlets and CORBA to develop Web-based enterprise applications. The coding and the test of the Web-based application were completed as a part of a graduate research project. The results of the project have been integrated to our on-going research project.

6.1 Project Description

We developed a three-tier Web-based enterprise application for conducting the entire survey process--from the survey form design, data collection and analysis to survey results presentation. The Web-based enterprise application was intended for an automobile company; however, the application can be used by organizations and companies. Three groups of users were identified: managers, salespeople and customers. The requirements in terms of the application functionality include: (1) managers can create/update survey questionnaires, and view the survey results periodically, (2) salespeople can generate a password for each new customer, and add/update customers' information in the company's database, and (3) customers can update their own information and fill out a survey form available on the company's web site only once. In addition, the application has some quality requirements in terms of scalability, portability, platform-independency, flexibility, maintainability, extensibility, manageability, usability and performance. The co-author completed the implementation and test of the Web-based application as a part of her master research project [Xu 1998].

6.2 Hardware and Software Resources

The project was carried out in the Client/Server Laboratory at San Jose State University. The lab has a network of 25 NT machines. The following software products were used in the project: (1) Visigenic's Visibroker for Java 3.02, (2) Microsoft Windows NT 4.0 Server, (3) Symantec Visual Café PDE 2.1, (4) JavaSoft JDK 1.1.6, (5) Microsoft SQL Server 7.0, (6) Java Web Server 1.1, (7) Netscape Communicator 4.06 with JDK1.1 patch, and (8) Netscape Enterprise Java Web Server 1.1. The above software products were updated routinely.

6.3 Evaluation

The results were evaluated by industry representatives and several faculty members (including the author) having industrial experience. The Web-based application has met the project functionality and quality requirements.

7. Lessons Learned and Future Plans

The number of clients who can connect to a server is restricted by the capacity of the database connectivity. The scalability is improved as a result of using servlets. Furthermore, with the inherited threading and techniques like database connection pooling and caching, servlet-based solutions handle the pressure [Bergsten 1998]. Additionally, adopting JavaBeans technology helps to reduce significantly the application development time.

Such R&D projects provide the opportunity for students to gain valuable experience in developing multi-tier Web-based applications and adopting rapidly evolving Java-based technologies and CORBA. It helps significantly if students gain experience with JavaBeans and ORBs in a couple of smaller projects before they work on similar projects. The results of the project have been used in our on-going CBESD research. Based on our experience, conducting such R&D projects at the university provides students with a beneficial educational opportunity, and industry is supportive. That is why the author has continued to supervise similar graduate research projects.

References

[Bergsten 1998] Bergsten, H. (1998). Servlets Are for Real!. http://webdevelopersjournal.com/columns/java_servlets.html

[Liu 1997] Liu, S.Q. (1997). Common Framework with Transaction Processing Monitor. *San Jose State University*.

[McGraw 1999] McGraw, G. and Felten, E. (1999). *Securing Java*, Wiley.

[Morrison 1997] Morrison, M (1997). *Presenting JavaBeans*, Sams.net.

[Orfali 1998] Orfali, B. and Harkey, D. (1997). *Client/Server Programming with Java and CORBA*. Wiley.

[Orfali 1997] Orfali, B., Harkey, D. and Edwards, J. (1997). *Instant CORBA*. Wiley.

[Pope 1998] Pope, A. (1998). *The CORBA Reference Guide*. Addison-Wesley.

[Pour 1999a] Pour, G., Griss, M. and Favaro, J. (1999). Making the Transition to Component-Based Enterprise Software Development: Overcoming the Obstacles - Patterns for Success. *International Conference on Technology of Object- Oriented Languages and Systems (TOOLS Europe '99)*, Nancy, France.

[Pour 1999b] Pour, G. (1999). Integrating Component-Based Enterprise Application Development into Software Engineering Curriculum. *Frontiers in Education (FIE '99) Conference*, San Juan, Puerto Rico.

[Pour 1999c] Pour, G. (1999). Java-Based Component Model for Enterprise Application Development. *International Conference on Technology of Object-Oriented Systems and Languages (TOOLS USA '99)*, Santa Barbara, CA.

[Pour 1998a] Pour, G. (1998). Developing Web-Based Enterprise Applications with Java, JavaBeans, and CORBA. *World Conference of the WWW, Internet, and Intranet (WebNet '99)*, Orlando, FL.

[Pour 1998b] Pour, G. (1998). Moving Toward Component-Based Software Development Approach. *International Conference on Technology of Object-Oriented Languages and Systems (TOOLS ASIA '99)*, Beijing, China.

[Pour 1998c] Pour, G. (1998). Component-Based Software Development: New Opportunities and Challenges. *International Conference on Technology of Object-Oriented Systems and Languages (TOOLS USA '98)*, Santa Barbara, CA.

[Pour 1994] Pour, G. (1994). Port of HP Distributed Object Management Facility to IBM AIX System. *Hewlett-Packard Professional Women's Conference*, Andover, MA.

[Radding 1998] Radding, A. (1998). CORBA Takes Off. *Information Weeks*, 9 (2).[Savit 1998] Savit, J., Wilcox, S. and Jayaraman, B. (1998). *Enterprise Java*, McGraw Hill.

[Shaw 1996] Shaw, M. and Garlan, D. (1996). *Software Architecture: Perspectives on an Emerging Discipline*. Prentice-Hall Inc.

[Xu 1998] Xu, J., (1998). Web-Based Customer Relation Office, *San Jose State University*.

Creating a Web-based Spatiotemporal GIS using Java and VRML

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Abstract: This paper presents our approach towards creating a Web-based Spatiotemporal Geographic Information System, in particular, the creation of the spatial data set and the component interaction. It explores the possibility of rendering Virtual GIS Worlds in near real time across the WWW using a standard Web browser as the user interface.

A "proof of concept" Web-based VGIS application was developed to investigate methods for the efficient transfer of high-bandwidth multimedia GIS content over the WWW, as well as providing a suitable development environment for research into Web-based Temporal GIS. This paper describes how VRML and Java were used to provide the visualisation of virtual worlds, interaction with individual objects inside the virtual world, and the query tools for adding, deleting, selecting or manipulating these objects or their associated attribute data.

1. Introduction

If "a picture is worth a thousand words", imagine what a virtual world is worth. Fully interactive real-time virtual environments and multidimensional data visualisation hold great potential for increasing our understanding of a wide variety of inherently visual data, as well as reducing the mean time taken to understand such information.

The project described in this paper investigates the feasibility of creating a Virtual GIS application in the constrained environment of Web applications. Our aim is to use existing Web technologies and protocols, rather than develop a proprietary solution, as one of the goals of the project is to develop an extensible, open system for visualising and sharing 3D data across the WWW. It is also our goal to extend this Web-based VGIS to support temporal operations, thus creating a 4D web-based Spatiotemporal GIS.

2. "Proof of Concept" System

In order to establish that the requirements of such a system could be met, and the complexity of such a system fully understood, a "proof of concept" system was implemented. This system, based on the model in [Fig. 1] below, provides a suitable development platform for investigating methods for the efficient transfer of high-bandwidth multimedia GIS and VGIS content over the WWW, as well as a suitable development environment for research into Web-based Temporal GIS.

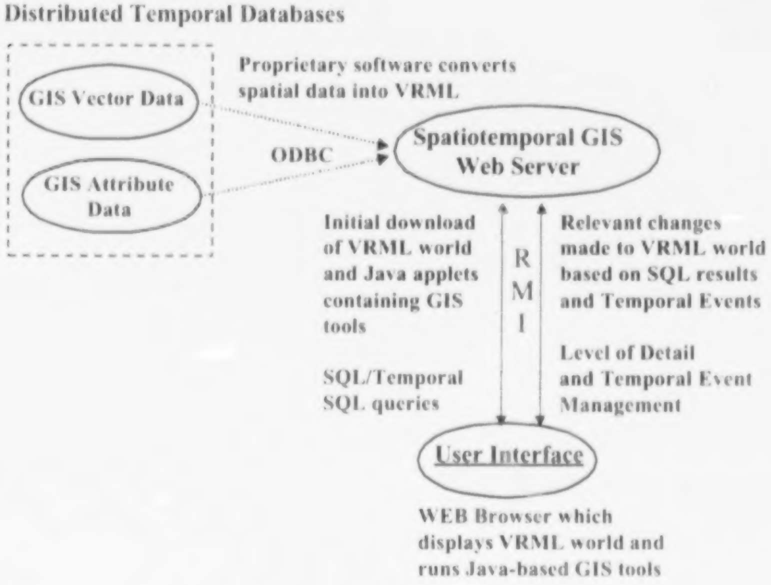

Distributed Temporal Databases
GIS Vector Data
GIS Attribute Data
Proprietary software converts spatial data into VRML
ODBC
Spatiotemporal GIS Web Server
Initial download of VRML world and Java applets containing GIS tools
SQL/Temporal SQL queries
R M I
Relevant changes made to VRML world based on SQL results and Temporal Events
Level of Detail and Temporal Event Management
User Interface
WEB Browser which displays VRML world and runs Java-based GIS tools

Figure 1: "Proof of Concept" System

One of the goals of creating our Web-based Virtual GIS application was to remove as much of the complexity and expense from the client side as possible. Therefore, some of the issues that affected our choice of approach, included:

- Modularity
- Extensibility to handle complex data types
- Security over the network/internet
- Data integrity
- Minimise initial setup complexity
- Per seat licensing costs

Once a basic level of operation had been established, according to the model above, benchmarks and refinements were made in order to minimise client-side setup, bandwidth traffic, and computational complexity.

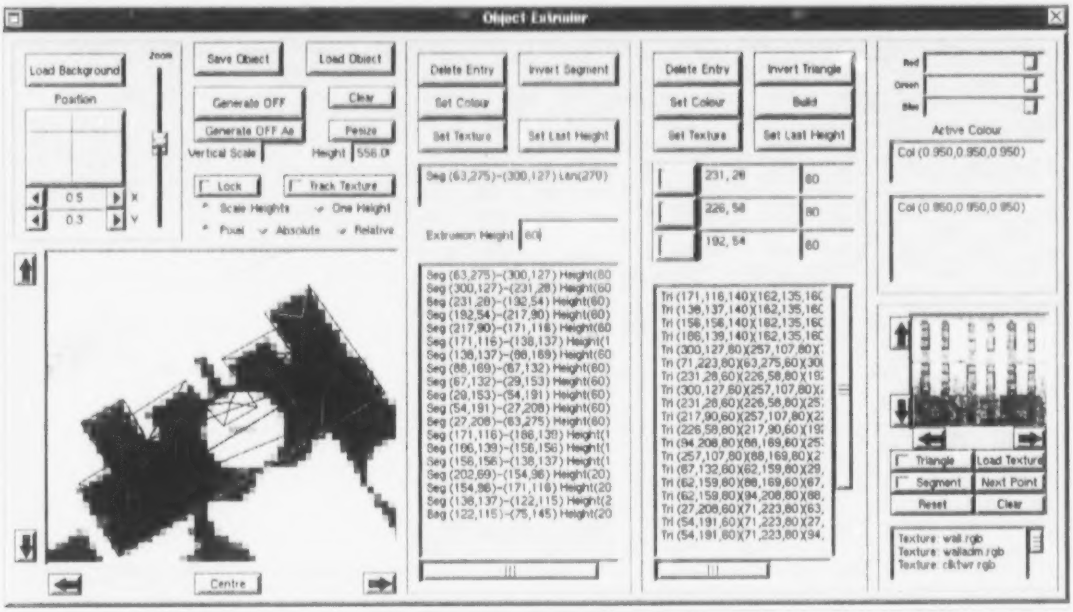
3. Components of the "Proof of Concept" system

A graphical user interface, with built-in support for WWW access, for interacting with the VGIS system was required. A WEB browser such as Netscape or Internet Explorer provides the necessary graphical interface with WEB access, and plug-in support for developing WEB protocols, built-in.
A Virtual Reality modelling and scene description language that is supported by WEB browsers was needed to provide an interactive environment as opposed to viewing pre-generated images, as is widely implemented by current GIS applications. VRML is currently the most widely available WEB oriented Virtual Reality modelling and scene description tool available, and VRML plug-ins are freely available for popular WEB browsers.

GIS functionality must be portable across platforms if it is to be truly WEB based. Currently Java applets provide the most logical solution and also introduce some interesting prospects for scaleable GIS systems. Due to the fact that each applet downloaded may access the scene graph, and may then effect changes to the scene graph independently, it is possible to create each GIS tool as a separate applet. Therefore, additional modular GIS components can be purchased and/or downloaded to provide the user's required level of GIS functionality. Java and JavaScript can be used in conjunction with VRML through the External Authoring Interface (EAI) and SCRIPT nodes respectively, thus providing even more reason for the choice of VRML for modelling and scene description. However, it should be noted that one immediate problem with the use of separate applets for each GIS tool, is the way the scene graph interacts with the EAI. Each applet is only able to see/keep track of what happens to the base scene graph, and will not be able to see any nodes added to the base world using the `createVRMLFromString` or `createVRMLFromURL` by another applet. For further information about the restrictions on the accessibility of nodes using the EAI, please refer to [Marrin 1997].

4. Creation of the Spatial Data Set: Virtual Grahamstown

Maps of Grahamstown were obtained from the Town Engineers office, and scanned in. The outlines of the buildings and roads were "digitised" in order to provide a template for specifying the shape, size and spatial arrangement of these features. Using a specialised extrude tool, written by Professor Shaun Bangay [Bangay 1997], see [Fig. 2], created specifically for the purpose of creating the objects in the virtual world, the walls of buildings were raised to the appropriate levels, and then a roof was added. The resultant three-dimensional volume represents the outside of the building, and is stored as a set of polygons that make up the walls and roof of the virtual building. This model could then be used directly in RhoVeR, the Rhodes University Virtual Reality System, or exported to VRML for use in our VGIS.


Object Extruder
Load Background
Zoom
Position
X
Y
Save Object
Load Object
Generate OFF
Clear
Generate OFF As
Resize
Vertical Scale
Height
Lock
Track Texture
Scale Heights
One Height
Pixel
Absolute
Relative
Centre
Delete Entry
Invert Segment
Set Colour
Set Texture
Set Last Height
Extrusion Height
Delete Entry
Invert Triangle
Set Colour
Build
Set Texture
Set Last Height
Red
Green
Blue
Active Colour
Triangle
Load Texture
Segment
Next Point
Reset
Clear

```
Height 556.0
0.5
0.3
```

```
Seg (63,275)-(300,127) Len(270)
Extrusion Height 60
```

```
Seg (63,275)-(300,127) Height(60
Seg (300,127)-(231,28) Height(60
Seg (231,28)-(192,54) Height(60)
Seg (192,54)-(217,90) Height(60)
Seg (217,90)-(171,116) Height(60
Seg (171,116)-(138,137) Height(1
Seg (138,137)-(88,169) Height(60
Seg (88,169)-(67,132) Height(60)
Seg (67,132)-(29,153) Height(60)
Seg (29,153)-(54,191) Height(60)
Seg (54,191)-(27,208) Height(60)
Seg (27,208)-(63,275) Height(60)
Seg (171,116)-(186,139) Height(1
Seg (186,139)-(156,156) Height(1
Seg (156,156)-(138,137) Height(1
Seg (202,69)-(154,98) Height(20)
Seg (154,98)-(171,116) Height(20
Seg (138,137)-(122,115) Height(2
Seg (122,115)-(75,145) Height(20
```

```
231, 28   60
226, 58   60
192, 54   60
```

```
Tri (171,116,140)(162,135,16
Tri (138,137,140)(162,135,16
Tri (156,156,140)(162,135,16
Tri (186,139,140)(162,135,16
Tri (300,127,60)(257,107,60)(
Tri (71,223,60)(63,275,60)(30
Tri (231,28,60)(226,58,60)(19
Tri (300,127,60)(257,107,60)(
Tri (231,28,60)(226,58,60)(25
Tri (217,90,60)(257,107,60)(2
Tri (226,58,60)(217,90,60)(19
Tri (94,208,60)(88,169,60)(25
Tri (257,107,60)(88,169,60)(2
Tri (67,132,60)(62,159,60)(29,
Tri (62,159,60)(88,169,60)(67,
Tri (62,159,60)(94,208,60)(88,
Tri (27,208,60)(71,223,60)(63,
Tri (54,191,60)(71,223,60)(27,
Tri (54,191,60)(71,223,60)(94,
```

```
Col (0.950,0.950,0.950)
Col (0.950,0.950,0.950)
```

```
Texture: wall.rgb
Texture: walladm.rgb
Texture: clktwr.rgb
```

Figure 2: Screenshot of Extrude utility

Since each object will be used together with many other objects in a virtual world where the speed of interaction is important, there is a trade-off between the level of detail (LOD) of the structures and the final rendering speed. It is therefore assumed that a simplified outline for the building is sufficient for most objects. However, should more detail be required for a particular object, that object can also be created at a greater LOD and used together with VRML `LOD` and `InLine` statements to provide greater detail.

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Once the structures had been created, it was then possible to add colour and to map textures to the buildings to add realism to them. See [Fig. 3] for a sample snapshot from Virtual Grahamstown illustrating the realism achieved by adding colour and textures.

Colour, as opposed to texture mapping, was used where the significance of the building was low, or the building was being drawn at a lower level of detail, or where the texture of an area would have been relatively plain. This reduced the scene complexity and increased the speed of rendering the scene.

The use of textures for important landmarks, however, is almost mandatory, and the resulting realism is extremely high. The texture maps for these buildings were obtained by taking still-shots of the actual buildings using a video recorder. While the use of texture mapping is relatively resource intensive, there are ways to minimise the effect of using textures within a scene, and to reduce memory usage at rendering time. These include:

- Repeating the texture both horizontally and vertically, allowing areas with repeated features to be efficiently generated from only a single instance of the texture of that feature.

- Selecting active areas of the texture allows reuse of the texture maps for cases where only smaller portions of the texture are required. For example a texture used for an entrance arch with window above, could equally well be used for a wall with just a window of the same shape.

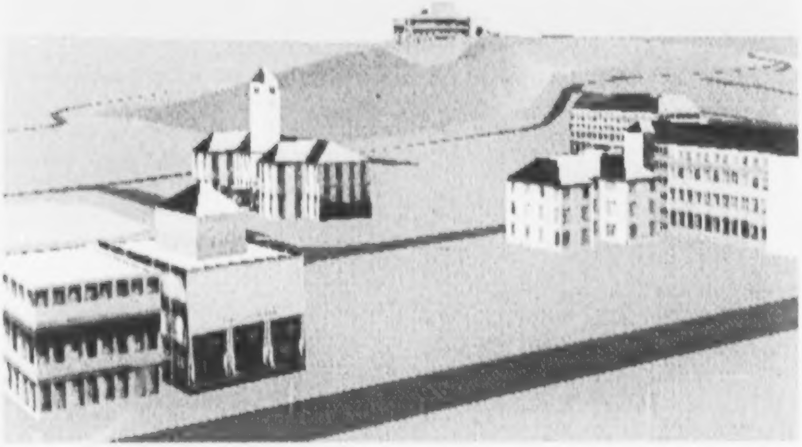

Figure 3: A snapshot of Rhodes campus looking towards the Grahamstown Monument

5. Component interaction: Manipulation of the Spatial data

The user, using a standard WEB browser, will download the VGIS - both spatial information and Java applets implementing GIS tools - from a WEB Server that is specialised to deal with VGIS requests. From this point, the user's interaction with the VGIS will determine what events are triggered.

These events are not limited to, but may include accessing remote DBMSs to retrieve attribute information, and changing the user's view and/or interaction with the VGIS.

The Web page downloaded by the client contains an embedded VRML World and one or more Java applets that use the EAI to connect to the VRML World. In our application we make use of two applets: one displays meta data about the attribute database; and the other allows the user to make SQL queries and manipulate the scene graph according to the results of the SQL query.

User selected, or "intelligent", negotiation with the VGIS WEB server regarding the level of detail (LOD) of a scene provides a means for optimising bandwidth-related download delays, and increasing rendering speed for near real-time interaction.

The results of an SQL query can be used to change which buildings are displayed, and/or change the attributes, e.g. colour, material, etc. of particular buildings within the scene. The ability to add, update or remove a single object from the scene graph allows one to perform "live" updates. Therefore, should new objects become available as part of the spatial data set, these new objects can be added to the scene graph automatically and/or manually.

6. Conclusion

This developmental system is intended to become a useful information tool as well as being an important research tool for combining GIS, distributed multimedia and temporal data. Our VGIS extends current GIS systems in that it is a scaleable, WEB-based, virtual GIS that is platform independent. All the above features are highly desirable on their own, but when combined, should provide enough functionality to attract commercial interest, while also providing GIS facilities to the Internet community as a whole.

Due to the graphics intensive nature of the VGIS, specialised hardware may be required to deliver near real-time interaction. However, even with an ordinary graphics card, interaction with the VGIS, while slow at times, would almost always outperform a similar system which downloads pre-rendered images according to the user's selection. The major bottle-neck is currently the bandwidth available on the WWW, especially in South Africa. The following optimisations, however, provide essential optimisation techniques for reducing the impact on limited available bandwidth and processor power:

- The decomposition of scenes into individual objects of user-defined granularity.
- The ability to select only the objects of interest for detailed analysis as opposed to having to download an entire GIS coverage.
- The use of VRML ShapeHints and level-of-detail (LOD) to decrease scene complexity, and increase rendering speed.
- The use of progressive LOD, which has the additional advantage of not increasing the bandwidth required to download objects of increasing LOD because only the increased object complexity needed to be downloaded, rather than the same object at the new level-of-detail.

7. Future Research: Integration of Temporal Data into VGIS

Spatial objects can change shape and/or position over time. Therefore one needs to be able to model these changes and also to be able to query the objects according to spatial and temporal criteria. The user must have the ability to perform a combined spatial and temporal query, e.g. how many objects were in a particular radius at a specific time. Where possible one must be careful not to duplicate information stored about these objects, i.e. one must not store information that can be formulated from relationships between other spatial, temporal or attribute data. Even though the spatial objects are changing with time, it is also essential to have some sort of history associated with these objects so that one may determine what happened in the past, and hopefully also to be able to make predictions. Predictions using statistical methods/interpolation would then, for example, allow one to ask how many objects one could expect in a particular radius, at a specific time, for which one does not have the actual data [Preston 1998].

Temporal databases are designed to reflect the changes that occur over a period of time by keeping records of past states. However, because databases may be manually updated, there is often a discrepancy between when an event occurred and when the transaction to record that event was processed.

Currently we are exploring the following two approaches to implementing temporal support in existing non-temporal object-oriented DBMSs, for implementing a temporal object database, for use in our "Proof of Concept" Web-based Spatiotemporal GIS application:

- *Creating a temporal front-end to a non-temporal object database.* One of the drawbacks of implementing an ADT for time, is that it becomes difficult to write temporal queries because the object query language does not support temporal queries. However, by creating a separate front-end which specifies that all queries should be evaluated temporally and all constraint checking performed by a temporal constraints manager, it is possible to provide an easier to understand and use, less error prone system. A similar idea was implemented in TimeDB [Steiner 1998], which is a front-end to an underlying non-temporal relational database. However, the advantages of using an object-oriented database merit research into the implementation of a temporal front-end to an ADT for time in an underlying non-temporal object-oriented database.

- *Implementing temporal support through the use of extensible object identifiers, an extensible query language and the possibility to overwrite algebraic operators for different ADTs.* This involves the possible implementation of the ideas developed in TOMS [Steiner 1998] using the OODBMS OMS. This will allow the overwriting of methods and operators at lower levels within the object DBMS as opposed to implementing a separate, higher-level interface to manage temporal ADTs. The ideal would be to have access to extensible object identifiers, an extensible query language and the possibility to overwrite algebraic operators for different ADTs.

The integration of a temporal database into our current "Proof of Concept" system, will create the need for further research into Spatiotemporal GIS applications. In particular, the concept of how the timestamps stored for each entity in the temporal database should affect the visualisation and spatial querying of these objects, must be studied.

8. References

[Bangay 1997] Bangay, S. (1997), *30 Days to Build a City: Building Virtual Worlds from Maps*, Computer Science Department, Rhodes University.

[Marrin 1997] Marrin, C. (1997), *Proposal for a VRML 2.0 Informative Annex: External Authoring Interface Reference*, Silicon Graphics, Inc., ON-LINE http://www.vrml.org/WorkingGroups/vrml-eai/ExternalInterface.html

[Preston 1998] Preston, M. (1998), An Overview of Temporal Object Models and their application to GIS, *South African Telecommunications, Networks and Applications Conference (SATNAC)*, 1998, University of Cape Town.

[Steiner 1998] Steiner, A. (1998), *A generalisation approach to Temporal Data Models and their implementation*, Doctor of Technical Sciences thesis, Swiss Federal Institute of Technology, Zurich.

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Extensive Application of Electronic Mail in a Five-phase Computer-supported Meeting

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Abstract: Electronic mail (email) is undoubtedly a very widely used form of communication. Not only in government, education and business sectors, but also in day-to-day affairs of everyday people. Given its immense usefulness and relevance in communication, email is naturally applicable in a computer-supported meeting. Logan is a *Web Electronic Meeting Document Manager* (WEMDM) that specialises in provision of a wide range of document functionality for such meetings, for example, agenda and minutes development. Logan uses email extensively in meeting processes—more widely than found in other meetings support systems. For instance, four types of agenda-related messages and one type of message for rejected agenda contributions sent during the pre-meeting phase of a meeting. Such extensive use occurs because email is a vital mechanism required for Logan meeting processes.

Introduction

Electronic mail (email) has proven to be a highly popular method of communication nowadays. Email is widely used in business, education, government, and now, socially amongst everyday people. Email is useful where communication is asynchronous and thus users are allowed some time to respond to messages. Email is also beneficial in a workplace setting where many users keep their email inboxes open continually and may therefore be updated continually with important information. Users may also read and respond to messages independently of each other. Users may very easily store personal copies of messages for future use. For these reasons, email is appropriate and effective in support of processes during a computer-supported meeting.

Associated with email are issues of usability and user interface. Like other user interfaces, such as Web pages, email messages must be designed to provide all necessary information in an efficient and yet effective manner. However, as far as much email software goes, message content is presented in a very limited manner (e.g. ASCII text, single font size and type) and so content must apply ASCII text, spacing and other characteristics effectively to enhance user satisfaction. Messages must be as usable as possible for employees whose work involves a large number of other tasks that must be carried out in addition to reading and responding to email.

Logan is a *Web Electronic Meeting Document Manager* (WEMDM). A WEMDM handles a range of document issues associated with meeting processes occurring before, during and after a meeting. Logan has been developed by the author to handle functions such as collaborative, asynchronous development of the agenda by the secretarius with participant input or generation of *derivatives*—documents where content results from textual analysis of meeting discussion.

The WEMDM is used in tandem with a discussion tool (*Yarn* [Rees et al. 1993] was used in experiments with Logan) used to display and capture verbatim remarks. A meeting supported by Logan involves both the roles of chairperson (the chairperson role in a traditional, face-to-face meeting) and a *secretarius*, who is a participant responsible for administrative meeting tasks like minutes creation.

A Logan meeting is described by the *meeting subphase model*. This model consists of five phases: pre-meeting, in-meeting and post-meeting phases, where the in-meeting phase consists of the three phases: startup, discussion and windup phases. This model is a variation of the general model put forth by [Dubs and Hayne 1992]. Logan handles document functionality across these five phases. Additionally, Logan handles *meeting chains*. A chain is a linear sequence of meetings, so that given any meeting in the chain, *A*, the meeting preceding *A* is the *last* meeting and the meeting subsequent to *A* is the *next* meeting. Meeting *A* depends on its last meeting for document input and provides documents as output to its next meeting.

Logan automatically generates and sends to participants a variety of email messages associated with meeting tasks. The tool derives message content automatically from its pages (such as the agenda) or configuration files (such as a file containing administrative details like date and time of a meeting, meeting name, etc.) and formats the messages appropriately. Messages are used for such purposes as informing participants of meeting details (not requiring an immediate response to the message) or for requesting some immediate response such as contributing items to the meeting agenda. Almost all messages are used within the pre-meeting phase. However, different instances of these messages may be used and sent multiple times during the phase.

This paper presents the types of email messages generated and sent by Logan during a full meeting. User interfaces of various messages are shown and described.

Meeting Tasks and Email

A Logan meeting consists of several tasks. Some tasks involve the email messages discussed in this paper. The tasks involving email, ordered chronologically and according to the phases in which they occur, are as follows:

Pre-meeting:

1. The secretarius initiates the agenda (including details such as tools for use in the meeting and the meeting purpose) requesting participants to contribute items to the agenda and indicate if available for the meeting at a date and time proposed by the secretarius.
2. Participants view and some or all of them respond to the message by contributing items to the agenda. For those items rejected from inclusion in the agenda, the contributing participants receive an email message notifying them of this rejection. However, participants use the reason for rejection as a guide to reformulate and re-submit more appropriate contributions (if they wish).
3. Participants use Logan to indicate availability for the meeting at the proposed date and time.
4. If one or more participants indicate that they are unavailable for the meeting at the proposed time, and if the presence of these participants is necessary, an email message is sent to all participants. This message contains a new date and time and requests participants to indicate availability for the meeting.
5. After the final date by which participants may submit contributions for the agenda, the secretarius finalises the agenda. The secretarius reminds participants of the meeting date and time.
6. If a finalised meeting needs to be postponed, a new email message is sent to participants notifying them of the postponement. Reasons for postponement include those such as network failure or a last-minute absence of the secretarius. A newly proposed date and time are included in this message.

Meeting:

Discussion occurs here.

Post-meeting:

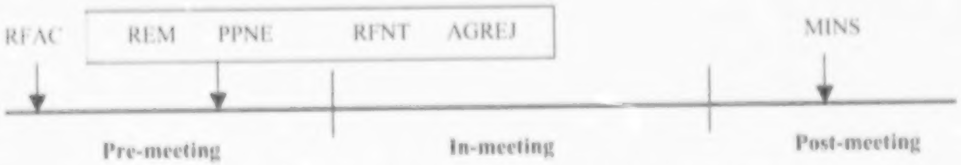
7. The secretarius generates the minutes of the meeting. An email message containing these minutes is sent to participants to review the meeting.

An item contains an item number, item description, time for discussing the item, initiator and documents as shown for the items 1 to 8 in [Fig. 3]. Rejection of items can occur because of a few reasons, but it is usually because of irrelevance of the item for achieving the meeting purpose.

The secretarius uses Logan to send several types of email messages to participants in accordance with the above tasks. These message types, as shown in [Fig. 1], and the corresponding tasks in which they were described above (identified by task number) are:

- Request for agenda contributions—requests participants to contribute items to the agenda (1)
- Meeting reminder—to remind participants of an impending meeting: the date and time when it will as well as other details such as the agenda items (5)
- Request for new time and contributions—this message is sent requesting participants to indicate availability to a newly proposed time and reminds participant that they may continue to contribute items to the agenda (4)
- Meeting postponement—this message is sent after a Meeting reminder which was sent previously, and attempts to reschedule the finalised meeting for another time (6)
- Rejected participant agenda contributions—a message sent to a single participant informing him/her that one or more submitted item contributions were inappropriate for inclusion in the agenda (2)
- Minutes—a message sent to participants for their own personal review of the meeting (7)

The *Request for agenda contributions* email is sent out before any other message. Participants may then respond by voluntarily contributing items. Following this message, four other possible messages may be sent (as shown in the box). These messages can occur in any order, with the exception that *a Meeting postponement* message would only occur once a meeting has been finalised. A *Rejected participant agenda contributions* message is sent only to a participant who contributes items the agenda.



Messages:				
AGREJ	Rejected participant agenda contrib's		REM	Meeting reminder
MINS	Minutes		RFAC	Request for agenda contributions
PPNE	Meeting postponement		RFNT	Request for new time and contributions

Figure 1: Types of email messages and points of distribution

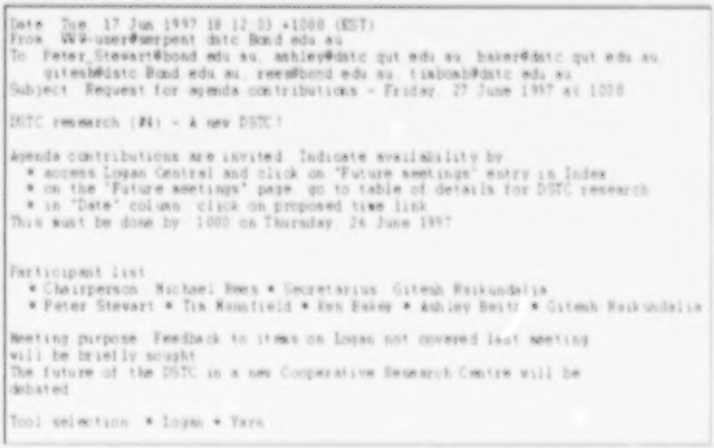
Message Types

The first four of the six types of messages described are referred to as *agenda-based messages*. This is because their content is derived largely from the meeting agenda, e.g., discussion items, meeting purpose, etc.

Agenda-based Messages

Request for agenda contributions

[Fig. 2] and [Fig. 3] represent the first and last part of the RFAC message, respectively. The secretarius will set some agenda items before this message is sent out. The message invites participants to add voluntarily to the items shown in [Fig. 3]. The message also prompts participants to indicate if they are available at the proposed date and time in the message (shown within the subject). The participant will then log into Logan to use the appropriate mechanism for availability indication. In the body of the message, the first line identifies the meeting. This line contains three attributes in the order: chain name, number of the meeting in the chain and meeting name.



```
Date: Tue, 17 Jun 1997 10:12:03 +1000 (EST)
From: WWW-user@serpent.dstc.Bond.edu.au
To: Peter_Stewart@bond.edu.au, ashley@dstc.qut.edu.au, baker@dstc.qut.edu.au,
    gitesh@dstc.Bond.edu.au, rees@bond.edu.au, timbomb@dstc.edu.au
Subject: Request for agenda contributions - Friday, 27 June 1997 at 1000

DSTC research (#4) - A new DSTC?

Agenda contributions are invited. Indicate availability by
  * access Logan Central and click on 'Future meetings' entry in Index
  * on the 'Future meetings' page, go to table of details for DSTC research
  * in 'Date' column, click on proposed time link
This must be done by: 1000 on Thursday, 26 June 1997


Participant list
  * Chairperson: Michael Rees * Secretarius: Gitesh Raikundalia
  * Peter Stewart * Tim Mansfield * Ken Baker * Ashley Beitz * Gitesh Raikundalia

Meeting purpose: Feedback to items on Logan not covered last meeting
will be briefly sought
The future of the DSTC in a new Cooperative Research Centre will be
debated

Tool selection: * Logan * Yarn
```

Figure 2: Request for agenda contributions—first part

The next component of the message indicates the purpose of the message. The five-line paragraph informs participants that they are invited to contribute to the agenda and provides instructions for indicating participant availability. In [Fig. 2], the date and time by which participants indicate their availability, in order to determine if the proposed time should be finalised, is 24 hours before the proposed time. In this example, the proposed time is 1000 on Friday, so participants have until 1000 on Thursday to indicate if available or not for the meeting. Details of participants, meeting purpose and tools for use in the meeting follow these instructions. These three sections will not need to be shown repeatedly in later Figures.

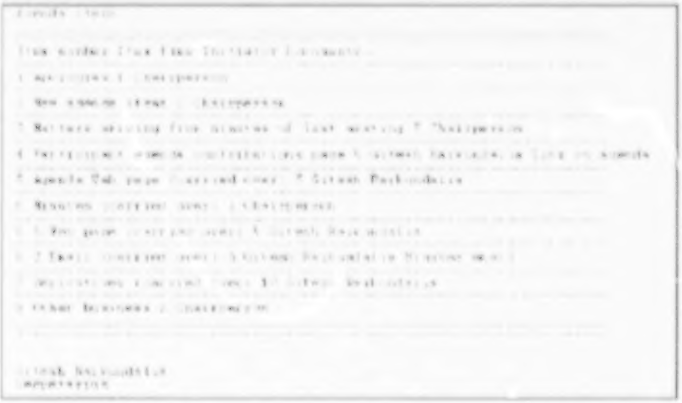


Figure 3: Request for agenda contributions—second part

[Fig. 3] displays the remainder of the message also found as the second part of the messages in [Fig. 4] and [Fig. 5]. The data of the table is placed in columns of varying width. Referring to the first item, the word "Apologies" is the only occupant of the column for indicating the item name. A space delimits the *Item* column and the *Time* column. An item's details are stretched across a row. In practice, an item at the most requires two lines for a row, where information on the first line wraps around to the second line. Lastly, the secretarius' sign-off is included.

Request for new time and agenda contributions

The Request for new time and agenda contributions email message is very similar to RFAC message. The differences include the following. A different subject ("Request for new time and agenda contributions") is

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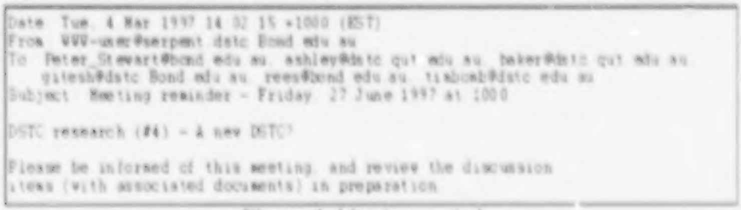
shown without the proposed date and time. Extra text is added to the beginning of the message purpose "Due to lack of availability for <date and time> a new meeting has been proposed". The date and time is therefore shown instead just above the meeting purpose to highlight the fact that a new date and times is the issue of the message.



```
Date: Tue, 4 Mar 1997 14:32:15 +1000 (EST)
From: WWW-user@serpent.dstc.Bond.edu.au
To: Peter_Stewart@bond.edu.au, ashley@dstc.qut.edu.au, baker@dstc.qut.edu.au,
    gitesh@dstc.Bond.edu.au, rees@bond.edu.au, timbomb@dstc.edu.au
Subject: Meeting reminder - Friday, 27 June 1997 at 1000

DSTC research (#4) - A new DSTC?

Please be informed of this meeting, and review the discussion
items (with associated documents) in preparation.
```

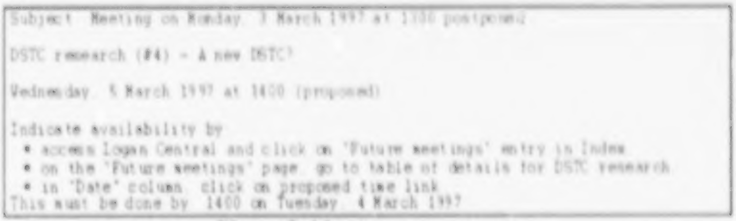
Figure 4: Meeting reminder

Meeting reminder

The meeting reminder is sent usually a short while before the meeting. Given that the time by which participants indicate availability is 24 hours ahead of the meeting, the meeting reminder will be sent usually within a few hours after this time. The meeting reminder is shown in [Fig. 4]. The only difference between the meeting reminder and previous messages is the second component of the body, informing participants of the meeting and reminding participants to view documents.

Meeting postponement

As explained above, reasons for postponement of a meeting exist (such as a network failure). This calls for a new time in order to carry out the meeting. An example of the email message sent to participants requesting availability to a newly-proposed time is shown in [Fig. 5]. Because the agenda is finalised, further contributions of items are not requested.



```
Subject: Meeting on Monday, 3 March 1997 at 1300 postponed

DSTC research (#4) - A new DSTC?

Wednesday, 5 March 1997 at 1400 (proposed)

Indicate availability by:
  • access Logan Central and click on 'Future meetings' entry in Index
  • on the 'Future meetings' page, go to table of details for DSTC research
  • in 'Date' column, click on proposed time link
This must be done by: 1400 on Tuesday, 4 March 1997
```

Figure 5: Meeting postponement

Rejected participant agenda contributions

This email may be viewed in [Fig. 6]. The body of the message begins with a statement indicating that the message contains rejected agenda contributions and the reasons for rejection. All contributions rejected by the secretarius are displayed in the message, one after the other. Details of an item are presented followed by the reasons for rejection of that item.

Minutes

The final email message to cover is that of minutes. An example of this message (partial capture) is found in [Fig. 7]. The message contains details of items as well as the outcomes, decisions and actions associated with an item. Logan allows the outcome of an item to be "Not discussed" where the item is not discussed in the meeting, and therefore the decision of such an item may be marked as "Carry over" to allow it to be discussed next meeting. Decisions and actions are optional for an item, such as for item 1 in the example.

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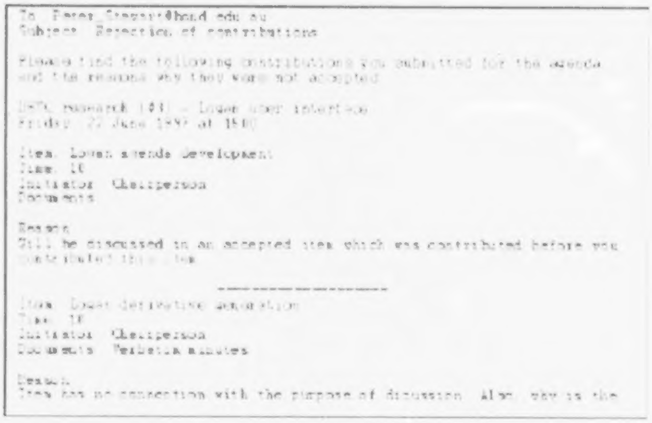


```
To: Peter_[illegible]@bond.edu.au
Subject: Rejection of contributions

Please find the following contributions you submitted for the agenda
and the reasons why they were not accepted

DSTC research (#4) - Logan user interface
Friday 27 June 1997 at 1500

Item: Logan agenda development
Time: 10
Initiator: Chairperson
Documents:

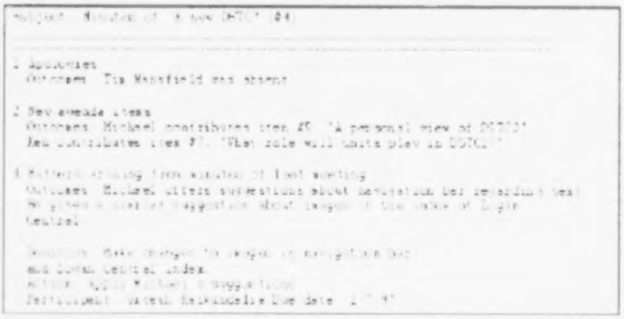
Reason:
Will be discussed in an accepted item which was contributed before you
contributed this item

                    ---------------------

Item: Logan derivative generation
Time: 10
Initiator: Chairperson
Documents: Verbatim minutes

Reason:
Item has no connection with the purpose of discussion. Also, why is the
```

Figure 6: Rejected participant agenda contributions



```
Subject: Minutes of [illegible] DSTC (#4)

1 Apologies
  Outcomes: Tim Mansfield was absent

2 New agenda items
  Outcomes: Michael contributes item #5: 'A personal view of DSTC?'
  Ken contributes item #7: 'What role will units play in DSTC?'

3 Matters arising from minutes of last meeting
  Outcomes: Michael offers suggestions about navigation bar regarding text
  He gives a similar suggestion about images in the index of Logan
  Central

  Decision: Make changes to images in navigation bar
  and Logan Central index
  Action: Apply Michael's suggestions
  Participant: Suresh Responsible Due date: [illegible]
```

Figure 7: Minutes

Conclusion

Logan generates a range of email messages for various tasks in a computer-supported meeting. Such communication is foundational for effective completion of tasks. This paper covered the different types of email and displayed user interfaces for them. Agenda-based messages, a message for notification of rejected agenda contributions and one for minutes were shown as well as points in the meeting of distribution to participants.

References

Dubs, S. and Hayne, S. (1992). Distributed facilitation: a concept whose time has come? *ACM 1992 Conference on Computer-supported Cooperative Work, 1992*, Toronto, Canada. 314-321.

Rees, M. J., Iannella, R., Lee A., Smith G. P., and Woo, T. K. (1993). Spinning a yarn: user interfaces for synchronous remote electronic meetings. *OZCHI93, 1993*, University of Canberra. 42-58.

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A Proxy-Based Personal Portal

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Abstract: Current portal services usually require a user to offer private information such as stock portfolio data or calendar events as a requirement to obtain useful services. Due to the ever increasing concerns over the lack of privacy protection on many web sites, such practices are becoming less attractive. This paper presents a *personal* portal implementation based on a client-side proxy server. Private information such as a user's web access history and stock portfolio is kept by the proxy, which uses agents to combine such information and rich content returned from portal companies to return personal and useful information to the user. We describe the architecture of the personal proxy server and several additional services that can be provided through this middleware approach.

This URL: *http://www.research.att.com/~iproxy/webnet99*

1. Introduction

Recently, there has been a heated competition among several companies to establish *portals*, websites that assemble an array of services and content to attract internet users. The consensus is that there will be only a few portals through which most customers access services and products on the internet[Wu 98]. Therefore, the most popular portals are likely to reap top advertisement dollars and E-commerce transaction fees. Existing portals such as My Netscape[Netscape 99], My Excite[Excite 99], and My Yahoo[Yahoo 99], are loaded with similar features such as search engines, stock quotes, maps, weather information, calendars, and news. However, many of these services have become commodities that you can obtain through companies like Infospace[InfoSpace 99]. Portal builders have been busy creating new services in a hope to retain existing customers. Examples include AOL's Instant Messenger[AOL 99], Netscape's Smart Browsing[Netscape 98a] and WebMail[Netscape 98b], InfoSeek's Express Search [InfoSeek 99], and Excite's Assistant. Many of these new services attempt to collect a user's profile information and detect the user's presence on the internet so as to create direct marketing channels to the user. However, none of these new services has the ability to combine the rich content from the portal server with sensitive and private information on the client side to provide a truly personal experience. For example, imagine that a user would like to get a list of stock quotes from the server and combine that with local stock portfolio information to compute and display the net gain/loss. Due to the ever increasing concerns over the lack of privacy protection on the web, the user may not want to give his or her financial details to the portal server, but this is usually required by all the portal implementations we know of.

This paper presents a personal portal implementation based on a client-side proxy server. Private information such as a user's web access history and stock portfolio is kept by the personal proxy, which uses agents to combine such information and rich content returned from portal companies to return useful and private information to the user. Section 2 gives an overview of iPROXY, a proxy server we have developed over the past few years as a research vehicle for developing new internet services using middleware. Section 3 describes a set of new services that can be provided through a client-side proxy. Section 4 describes how to put the pieces together to form a personal portal. Finally, Section 5 concludes with summary and future work.

2. Overview of iPROXY

iPROXY[iproxy 99] is a middleware for applications that access Web services. It can be installed as a personal proxy server running on an end-user's machine. It provides standard Web proxy API and functions of accessing, caching and processing web data. iPROXY allows users to configure and program its functionality, including the selection of the routes to access web servers (e.g., choosing different proxies for different hosts), how to archive web pages, recording and analysis of web access history, and management of the proxy's cache. iPROXY also provides hooks to plug in new functions that are able to process Web data received from Web servers. Hence, data from servers can be condensed, compressed, encrypted, or patched. The corresponding filters will convert pages back to their original form, or synthesize new pages from web data and personal information stored on the local disk. Finally, with a built-in Web server, iPROXY can also accept HTTP calls from Internet and trigger local applications to perform various services like event notifications, alerts, and data pushing.

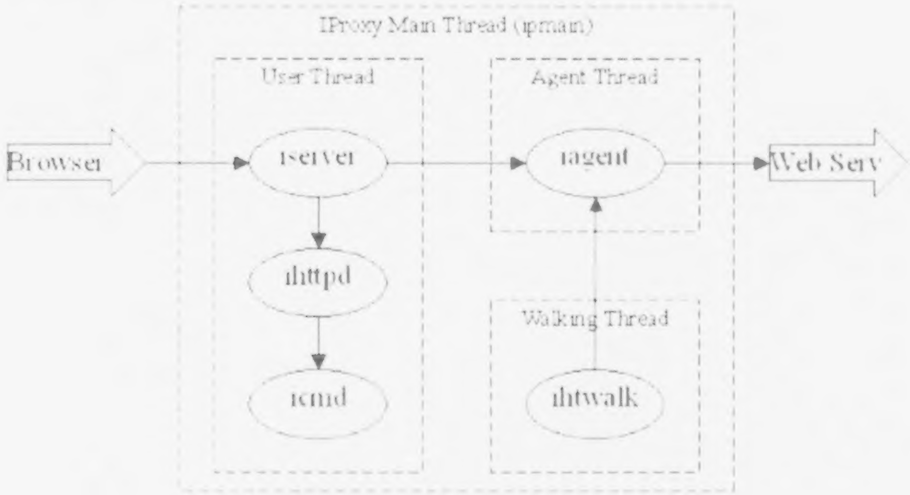

Figure 1: System Architecture of iPROXY

Figure 1 shows a high level view of the iPROXY system architecture. When iPROXY is started, the main thread listens on the proxy port and receives and responds to HTTP requests from clients (browsers or other proxies). The system creates a new user thread to serve each new request, which is delivered to **iagent** for remote web access or to **ihttpd** for local access. **ihttpd** implements a web server and will invoke **icmd** to interpret iPROXY commands embedded in html pages. **iagent** can also return pages to **ihtwalk**, an iPROXY facility to walk the html tree structure to collect and archive pages.

Figure 2 shows how filters can be applied to http headers, pages returned from the web, and pages returned from iPROXY's own cache. For example, an output filter can be used to add new components (menubars, etc.) or modify returned pages (replace some remote data with local data, etc.). As another example, a header filter can add a cookie and/or new header fields to an input HTTP request before forwarding it to Web server. These filters allow us the flexibility to implement several features in a personal portal, which will be described in the next section.

Most proxy servers are not designed with such flexibility in mind - one notable exception is IBM's WBI (Web Browser Intelligence) [Barrett & Maglio 99]. WBI is also a programmable proxy server that was designed for easy development and deployment of intermediary applications. However, it does not provide a built-in web server, or a simple scripting language that allows a programmer to mix HTML content with proxy-generated content.

Moreover, in WBI, filter functions are implemented as individual building blocks that are plugged in at initialization time. In iPROXY, however, filter functions are implemented as CGI-bin on Web servers and are named with regular URLs. Each filter function can reside on the iPROXY built-in server or any other remote web server. Compared with WBI, iPROXY's filter functions have a more straightforward API (i.e., CGI interface), a well-defined naming scheme (i.e., URL) and a more generic invocation method (i.e. HTTP).

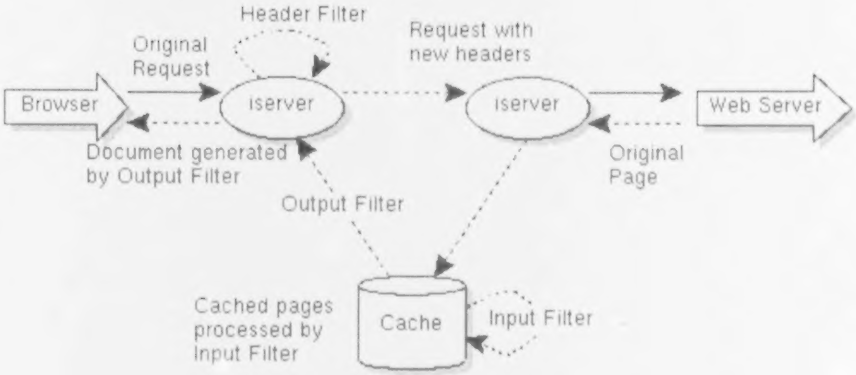
Header Filter
Original Request
Request with new headers
Browser
iserver
iserver
Web Server
Document generated by Output Filter
Original Page
Output Filter
Cached pages processed by Input Filter
Cache
Input Filter

Figure 2: iPROXY Filters

3. New Services Based on a Client-Side Proxy

Several new services can be provided with a client-side iPROXY that has access to the user's private information such as the web access history and personal finance information. In the following, we describe a few that we have implemented.

3.1 A Personal Web Archive

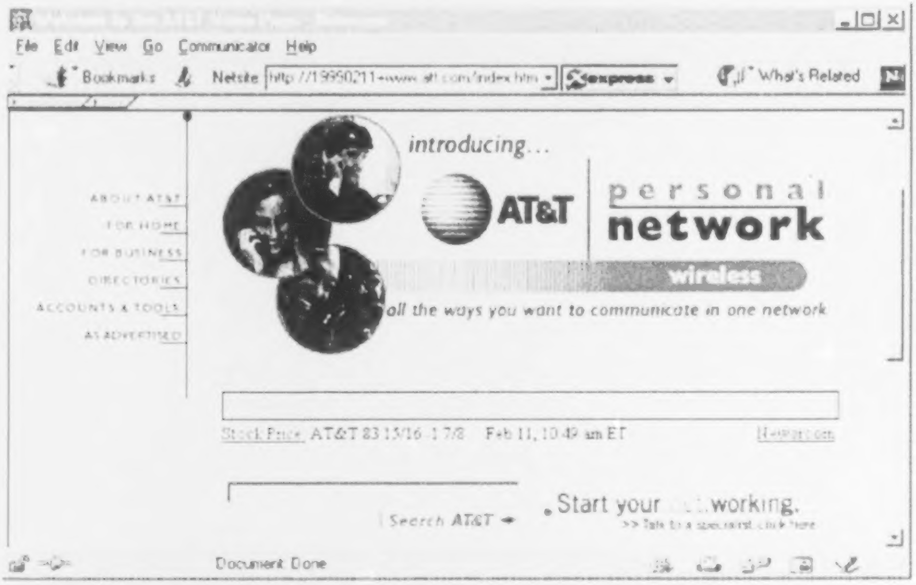
File Edit View Go Communicator Help
Bookmarks
Netsite http://19990211+www.att.com/index.htm
express
What's Related
introducing...
AT&T
personal network
wireless
all the ways you want to communicate in one network
ABOUT AT&T
FOR HOME
FOR BUSINESS
DIRECTORIES
ACCOUNTS & TOOLS
AS ADVERTISED
Stock Price AT&T 83 13/16 -1 7/8 Feb 11, 10:49 am ET
Search AT&T
Start your working.
Document Done

Figure 3: Using a *Persistent* URL to access AT&T's home page on February 11, 1999

While current search engines allow users to find pages of a certain topic easily, they do not offer much help in locating and viewing the pages a user has seen in the past, except for those that are still kept in the browser cache. Due to the sharp decrease of storage costs, a client-side iPROXY can afford to archive all the web pages a user has viewed so that any of these pages can be retrieved easily later on - without even bookmarking them. We can then

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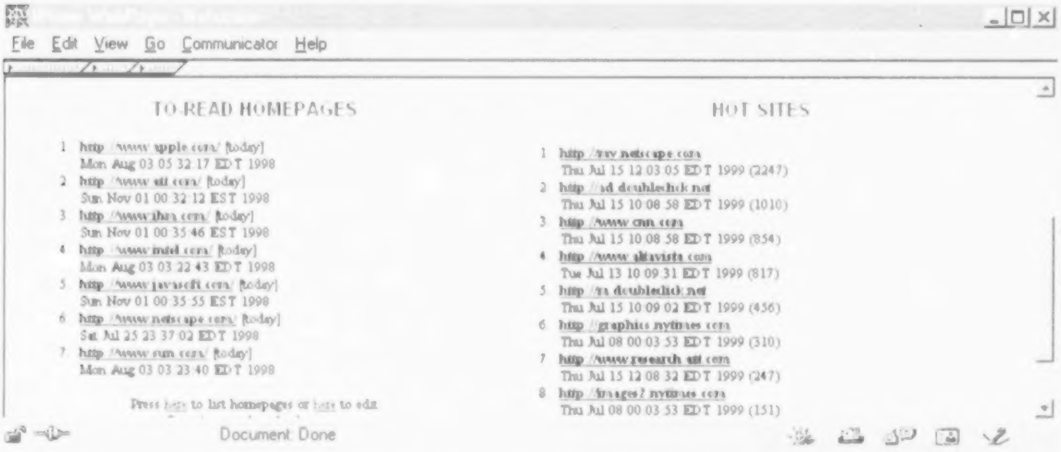
use existing tools like AltaVista Discovery to index and search these web pages. Our experience shows that an active web browser user can create a web archive of roughly 80-100 MB per month, including images and all sorts of documents downloaded. This amounts to around 1 GB of storage per year for all the pages a user has seen - increasingly affordable to many users.

Because iPROXY intercepts http requests, it can effectively extend the URL name space to address pages stored in the archive by adding a timestamp in front of the regular http address. For example, Figure 1 shows the February 11th version of AT&T's website captured that day. The URL is *http://19990211+www.att.com.* Even if the AT&T website goes through major redesigns, the above *persistent* URL will always give you the same content.

3.2 Personal Web Page Reminders and Hot Sites

Since a client-side iPROXY can log a user's web accesses, it can analyze the log and use the data to provide new web services that can help improve the user's browsing experience. Figure 4 shows two possible services:



TO-READ HOMEPAGES

1. http://www.apple.com/ [today]
   Mon Aug 03 05:32:17 EDT 1998
2. http://www.att.com/ [today]
   Sun Nov 01 00:32:12 EST 1998
3. http://www.ibm.com/ [today]
   Sun Nov 01 00:35:46 EST 1998
4. http://www.intel.com/ [today]
   Mon Aug 03 03:22:43 EDT 1998
5. http://www.javasoft.com/ [today]
   Sun Nov 01 00:35:55 EST 1998
6. http://www.netscape.com/ [today]
   Sat Jul 25 23:37:02 EDT 1998
7. http://www.sun.com/ [today]
   Mon Aug 03 03:23:40 EDT 1998

Press here to list homepages or here to edit

HOT SITES

1. http://my.netscape.com
   Thu Jul 15 12:03:05 EDT 1999 (2247)
2. http://ad.doubleclick.net
   Thu Jul 15 10:08:58 EDT 1999 (1010)
3. http://www.cnn.com
   Thu Jul 15 10:08:58 EDT 1999 (854)
4. http://www.altavista.com
   Tue Jul 13 10:09:31 EDT 1999 (817)
5. http://m.doubleclick.net
   Thu Jul 15 10:09:02 EDT 1999 (456)
6. http://graphics.nytimes.com
   Thu Jul 08 00:03:53 EDT 1999 (310)
7. http://www.research.att.com
   Thu Jul 15 12:08:32 EDT 1999 (247)
8. http://images2.nytimes.com
   Thu Jul 08 00:03:53 EDT 1999 (151)

Figure 4: TO-READ Home Pages and Personal HOT LIST

- TO-READ Homepages: A user can specify the list of websites and corresponding frequencies when certain websites should be visited. iPROXY can check the last visiting dates and schedule a list of pages that the user should visit today.
- HOT Sites: iPROXY computes the number of visits to each website and lists the top 10 websites with their last visiting dates accordingly as soon as the user accesses his or her personal portal. There are several advantages of having such a list: the user might want to (a) know the last visiting time of a favorite site - the timestamp is displayed along the website link, (b) access the latest version by clicking on the link, and (c) compare the new version with the old using tools like WebCiao[Chen and Koutsofios 97] or AIDE [Douglis et al. 98] because iPROXY can keep previous versions of the web pages that the user has visited.

In Section 4, we discuss how iPROXY scripting commands can be used to generate these two lists

3.3 My Stock Portfolio

Most portals allow users to specify the stocks that they are interested in and display the latest prices when the user accesses the personalized page. However, they cannot compute your current balance or net gain/loss unless you provide private and sensitive information like how many shares you own and when you purchased them. Such practice is certainly not desirable to many users. Figure 5 shows a typical portfolio view on Your WorldNet[ATT 99] . In this case, the user claims that he or she owns one share of AT&T, E*Trade, and Netscape stock each. No commission fees were paid and each stock was bought at $30.00. The portfolio service then returns the current

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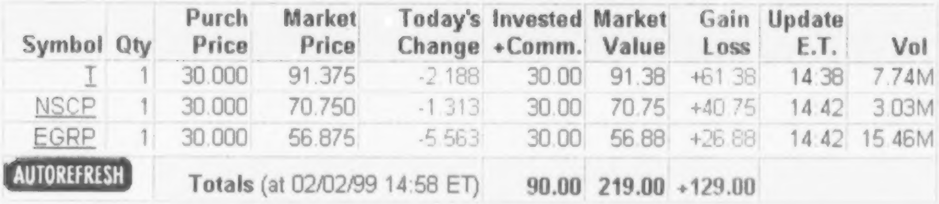
market price and net gain/loss information.



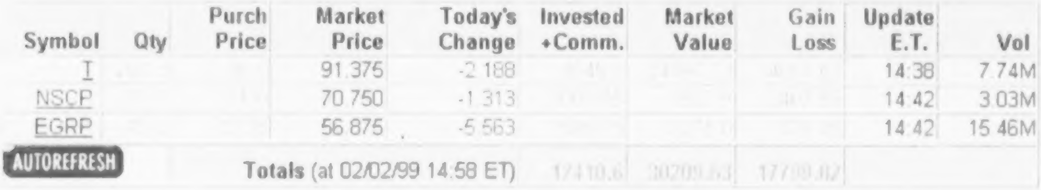
Symbol	Qty	Purch Price	Market Price	Today's Change	Invested +Comm.	Market Value	Gain Loss	Update E.T.	Vol
I	1	30.000	91.375	-2.188	30.00	91.38	+61.38	14:38	7.74M
NSCP	1	30.000	70.750	-1.313	30.00	70.75	+40.75	14:42	3.03M
EGRP	1	30.000	56.875	-5.563	30.00	56.88	+26.88	14:42	15.46M
AUTOREFRESH		**Totals** (at 02/02/99 14:58 ET)			**90.00**	**219.00**	**+129.00**		

Figure 5: My Portfolio from *Your WorldNet* without Private Information

Now suppose that the real purchase price, commission fees, and the number of shares of each stock are stored on the client machine. By constructing an output filter for the stock page, iPROXY can retrieve the private information, combine it with stock quotes provided by the portal site to compute the balance and net gain/loss. This is done by a specification like the following in iPROXY's configuration file:

```
OutputFilter /bin/portfolio.cgi http://stocks.planetdirect.com/portfolio.asp
```

It instructs iPROXY to apply the Java class **portfolio** on the local server as an output filter whenever the browser issues the corresponding http request. The real numbers are shown in Figure 6 - visible to the client only, and not to the portal server. The user actually bought 267 AT&T shares, 50 Netscape shares, and 40 E*Trade shares at the prices of $36.5, $21.0, and $39.38 each. The commissions were 0, $19.95, and $19.95. The total gain was $17,799.02. The numbers replaced by iPROXY are shown in green.



Symbol	Qty	Purch Price	Market Price	Today's Change	Invested +Comm.	Market Value	Gain Loss	Update E.T.	Vol
I	[illegible]	[illegible]	91.375	-2.188	[illegible]	[illegible]	[illegible]	14:38	7.74M
NSCP	[illegible]	[illegible]	70.750	-1.313	[illegible]	[illegible]	[illegible]	14:42	3.03M
EGRP	[illegible]	[illegible]	56.875	-5.563	[illegible]	[illegible]	[illegible]	14:42	15.46M
AUTOREFRESH		**Totals** (at 02/02/99 14:58 ET)			17410.6	30209.63	17799.02		

Figure 6: My Portfolio from *Your WorldNet* with Private Portfolio Information

One problem with this approach is that an output filter has to be written for each portfolio service and the filter is susceptible to changes in the format of the portfolio service. The problem might be reduced if more portal service providers start using XML to represent content on their websites to ease data extraction. Alternatively, if a portal server is aware of the potential existence of a client-proxy, then the two can work together seamlessly. This scenario is discussed in the next section.

4. A Proxy-Based Portal - Putting All the Pieces together

A proxy-based portal integrates content stored on a proxy server with those provided by a regular portal server such as *Your WorldNet*. Consider the following scenario where a portal server works in concert with a client-side proxy: a user sends the an URL with a proxy directive (starting with *?iproxy&*), *http://www.att.net/?iproxy&action=portal*, to the browser. iPROXY first retrieves the home page from *www.att.net*, which has encoded iPROXY directives that instruct iPROXY on how to process the local data and merge it with server content. It then presents the personal portal page back to the user. In order to provide a non-intrusive behavior to other users who are not using iPROXY, we embed the iPROXY directives in HTML comments in essentially the following way to generate the portal page shown in Figure 4:

```
<!----------------------- with iproxy only --------------------------->
```

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```
<!---:portal nop
        :portal version
        :portal to-read
        :portal dolog
        :portal top10
     :portal nop -->
```

iPROXY intercepts these directives and performs necessary actions before returning the portal page. The directive *version* prints out the version number of iPROXY. The directive *to-read* constructs the list of web pages scheduled to be read. The directive *dolog* analyzes the current web access log to produce the statistics. Finally, the directive *top10* presents the results on the personal portal. All these directives, being embedded in a comment, are ignored by browsers not using iPROXY.

5. Summary and Future Work

This paper shows how new web services such as archiving web pages, retrieving persistent URL's, listing frequently visited web pages, and computing personal portfolio based on private user data can all be implemented with the help of a client-side proxy server - without changing the existing browsers. These services are glued together to present a truly *personal* portal experience. We are currently conducting experiments on website differencing and archive searching, and we hope to work with internet service providers to bring these new services to internet users. You can download a copy of iPROXY software and its API document from *http://www.research.att.com/sw/tools/iproxy*.

References

[AOL 99] AOL Instant Messenger, http://www.aol.com/aim *America Online, Inc.* , January, 1999.

[ATT 99] Your WorldNet, http://yourworldnet.planetdirect.com, *AT&T*, January, 1999.

[Barrett & Maglio 99] Rob Barrett, Paul P. Maglio **Intermediaries: New Places for Producing and Manipulating Web Content** , Proceedings of the Seventh International World Wide Web Conference, Brisbane, Australia, 1998.

[Chen and Koutsofios 97] Yih-Farn Chen and Eleftherios Koutsofios, **"WebCiao: A Website Visualization and Tracking System,"** *Proceedings of WebNet97*, Toronto, Canada, October, 1997.

[Douglis et al. 98] Fred Douglis, Thomas Ball, Yih-Farn Chen, and Eleftherios Koutsofios **"The AT&T Internet Difference Engine: Tracking and Viewing Changes on the Web,"** *World Wide Web* Journal, Vol. 1, No. 1, Baltzer Science Publishers, January, 1998, pp. 27-44.

[Excite 99] My Excite, http://my.excite.com *Excite Ltd.*, January, 1999.

[InfoSpace 99] Infospace.com, http://www.infospace.com *Infospace, Inc.*, January, 1999.

[InfoSeek 99] InfoSeek Express, http://express.infoseek.com *InfoSeek Corporation*, January, 1999.

[iproxy 99] iProxy, http://www.research.att.com/~iproxy , *AT&T Labs*, January, 1999.

[Netscape 98a] Smart Browsing, http://home.netscape.com/communicator/navigator/smart.html , *Netscape Communications Corp.*, 1998.

[Netscape 98b] WebMail, http://webmail.netscape.com *USA.NET, Inc.*, 1998.

[Netscape 99] My Netscape, http://my.netscape.com *NetScape Communications Corp.*, January, 1999.

[Wu 98] Jim Hu, **Racing to the Start Line**, http://www.news.com/SpecialFeatures/0,5,22073,00.html, *CNET News.com*, May 14, 1998.

[Yahoo 99] My Yahoo, http://my.yahoo.com *Yahoo Inc.*, January, 1999.

Improving Teaching and Learning Through Web-Based Feedback

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Abstract: The power of technology to increase efficiency and workplace productivity can obscure its potential for transforming traditional practices, especially in the field of education. While technology can provide access to increasing numbers of students through distance learning, for example, it can also enhance student learning in traditional settings when used to facilitate specific practices that research indicates are important for learning. Feedback from and to students is one critical aspect of learning that we have addressed through three web-based systems we provide for our faculty members.

Introduction

Our Center for Teaching Excellence is charged with general faculty development as well as the use of technology to improve teaching and learning. In the latter mission, we work in cooperation with our Instructional and Educational Technology Division. West Point is an ideal environment to explore the use of technology to enhance student learning, since we have a ubiquitous computing environment and a robust infrastructure. In addition, we have developed a vision for the use of technology for instruction, and our hardware purchases and software development are geared to the accomplishment of that vision.

Since all faculty members and individual cadets have desktop computers, our intranet offers rich opportunities for the instructional use of technology. While we are engaged in the development of course Web pages and customized multi-media programs, we are also using technology to enhance the classroom learning environment by providing instructors with tools that create more "pedagogically meaningful relationships" with their students (Shulman, 1988). According to Shulman, interaction with students in such relationships should provide the faculty member with a pedagogical content knowledge that differs from the generic teaching skills and subject matter expertise so often assumed to be sufficient for college teachers. This pedagogical content knowledge enables faculty members to select and sequence learning activities to more effectively meet students' learning needs and more ably address student misconceptions and other difficulties with course material. Feedback from students has been documented as an important way to develop pedagogical content knowledge(Menges and Rando, 1998). We have developed three systems for USMA faculty members to use to elicit feedback from students, electronic tools to foster those "pedagogically meaningful relationships" that improve learning and teaching: end-of-course feedback, interim course feedback, and learning assessment.

End-of-Course Feedback

When USMA developed a model for centralized end-of-course feedback a decade ago, we eschewed the evaluative mode that has become so problematic in higher education (Gerstman, 1995). We opted for a purely formative system that provides information about an individual instructor's class solely to that instructor. Program directors, department heads, and the Dean all receive only aggregate information at their respective levels, information that is helpful for assessment and planning but that does not allow for evaluation of individual instructor performance. In its original paper and pencil format, student feedback was limited to responses to a standard set of questions, and the scoring of surveys delayed instructor access to survey information. Our electronic version has substantially expanded the system's potential to provide suitable information at every level easily and quickly. Originally begun as a cadet design project in a computer science class and further developed by one member of the design team as an independent student project, in 1998, the authors, drawing on the cadet work, took the system to this "next generation" providing its current flexibility.

In brief, the system protects the anonymity of instructors through a system of PINs used to control views of information. It operates in a cycle of phases. During phase 1, designated individuals in each department, the "trusted agents," organize the department's academic program as a hierarchy that reflects its organizational structure by creating "nodes" for designated units; that is, its programs, courses, and sections. They determine "who sees what" by setting access lists for each node. A faculty member with access to a node may write survey questions and receive a tailored report for each node. For example, the English Department head may write questions, and the report he receives will represent what every student taking an English course responded to those questions. The course director for freshman composition writes questions, and her report will contain the response of every student enrolled in freshman composition. Each composition instructor can write questions for his or her sections, and the reports will contain the responses of only the students in those sections. However, although the instructor can see how his or her students responded to the department head's questions and the course director's questions, neither the department head nor course director have access to information at levels lower than their own. The faculty members have most of the semester to create the department hierarchy and write questions because phase 2, student response, usually does not begin until the final week of class.

During phase 2, students respond to a unique, personalized survey for each class section they attend, created by the system on-the-fly by joining questions of relevant nodes. For instance, a student in the freshman computer science core course, CS105, hour D, section 1, will receive a survey potentially formed from questions written by the instructor particularly for this section, by the instructor for all his/her sections, by the course director of CS105, by the computer science program director, by the department head for all non-elective courses, and for the department as a whole. There is also a short list of standard questions for the entire Academy. While this may seem a daunting list, we have cautioned our faculty to make sure that individual student surveys not exceed a total of fifty questions and be closer to the thirty-question limit of our earlier paper version. Questions can be multiple-choice with or without a scale, with exactly one or any number of responses, and they can be "rank ordering" questions. Faculty members can ask for free text responses, which are delivered either only to the instructor (maintains high confidentiality) or "rolled up" at all nodes below the one where the question was asked (maximizes information). Questions can be "mandatory" or "optional" in the sense that surveys cannot be submitted while missing answers to mandatory questions. A sample of this system can be viewed at http://www.dean.usma.edu/feedback.

End-of-course feedback used as an evaluation of teaching is much criticized in higher education and remains largely because of what has been identified as the principle of faute de mieux, loosely translated as "lack of anything better" (Gerstman, 1995). A major problem is the tendency to mistake the numerical nature of the data with objectivity, ignoring the multitude of variables that affect student evaluation of instruction. However, when considered from the formative perspective, there is more of a tendency to see the feedback contexually, understanding it as the student impression of the learning situation and appreciating its value for certain types of informaton. For example, in our first semester core math course, the course director composed questions to obtain feedback on how well instructional intentions were meeting student learning needs, and he reported satisfaction with the results:

> The feedback let us know that most of the cadets (71%) felt that technology helped them understand mathematical concepts, 77% indicated that the emphasis we place on concepts rather than formulas helped them learn mathematics, and the requirement that they communicate mathematics by writing and briefings helped them learn the mathematics (76%). We take that as an indication that we are doing what we hope to do. (e-mail message from MA103 course director)

This same faculty member asked different questions of his own sections, seeking information about his individual classroom practices. He reported that he confirmed the value of cadets "going to the boards" to work problems but also students advised that he should be "more patient in waiting for cadets to finish problems on the boards," something he probably would not have learned without this type of feedback that allows fee text responses.

Interim Feedback

While our end-of-course feedback system has proven valuable as a formative instrument, it has limited usefulness in promoting "pedagogically meaningful relationships," since the students' responses are available only after the teaching/learning events have concluded. Feedback is essential to learning, and if we want our instructors to gain pedagogical content knowledge, they need to be getting feedback at more regular intervals during the teaching/learning process. "Feedback used in this way not only improves the experiences of students. It also enhances the teacher's sense of intentionality and control, factors essential to faculty well-being" (Menges and Rando, 1998). For some time, we encouraged our faculty members to do interim course feedback of their own design, but many were reluctant for a variety of reasons. They did not want to use class time. They believed that although students could report anonymously, they could be identified by handwriting (our classes are small) and would, therefore, not be candid. They were not sure how to do it properly; our Center for Teaching Excellence frequently received requests for sample questions to ask. We addressed all these issues by developing an electronic, web-based process that provides instructors with a simple, user-friendly, flexible means for obtaining student feedback that preserves student anonymity.

Complete instructions for use are available to faculty members on the CTE Web page (and can be viewed at http://www.dean.usma.edu/cte). This Web-based system is continuously available and functions with almost no administrative overhead. It provides an assortment of questions requiring free-text responses. In class (or via e-mail) instructors asks students to answer two or three from among the twenty questions the system offers. Students respond in private at their own computers. Responses appear anonymously in the instructor's e-mail. Since instructors need not use class time for this process, can insure student anonymity, and have a set of questions available to select from, the perceived constraints to interim feedback have been eliminated, and USMA faculty members use this system freely. In addition, the use of interim course feedback increases the validity and value of end-of-course feedback because eliciting student feedback at regular intervals throughout the course contributes to the development of the "pedagogically meaningful relationships" that encourage students to be candid in their responses.

A key factor in the success of this feedback system with our faculty is its ease of use. It is deliberately low risk, insuring instructor autonomy. Complete instructions for using the system with students resides on the CTE Web page, easily accessible to all instructors. They can choose the use the system at any time without getting any permissions or notifying anyone (other than their students) of their intentions. In many cases, instructor satisfaction with this system has led them to use the higher risk Learning Assessment system (described below) which is just as easy to operate technically but is considerably more challenging pedagogically. As one computer science instructor reported: "I used the Interim Feedback system last semester with my CS105 students. I am using both the Feedback and Assessment systems this semester with my CS380 students. I have found both to be very useful and have been very pleased with the info I got."

Learning Assessment

This instructor's transition to the more challeging process of learning assessment is the result of our further development of the principle of student feedback. The low risk nature of the Interim Feedback system led us to address a critical learning issue with a similar system. On average, today's students arrive at college significantly less well prepared academically than their counterparts in previous generations (Upcraft, 1995). They are often unfamiliar with independent studying, having done little homework in high school. This is a problem nationwide and a particular problem for us because our cadets do not have the luxury of "blowing off" a couple of years while they learn to study. They literally must "hit the ground running" when it comes to study and homework. We wanted to develop system that would help the instructor guide learning by monitoring cadet class preparation.

Using the Classroom Assessment Techniques (CATs) developed by Pat Cross and Tom Angelo in the mid-1980s and used successfully throughout higher education (Angelo & Cross, 1993), we created a Learning Assessment feedback system for student homework assignments.

Classroom Assessment has proven valuable in helping instructors monitor and improve their students' learning (Cross, 1996). An important factor in the process is student anonymity when reporting on their learning in classroom situations. We use CATs to help our instructors monitor and improve their cadets' learning outside the classroom--that is, in their homework assignments--through a Web-based feedback process. Our system enables instructors to assess student class preparation before the class meets, so that they can modify instruction to address the specific learning problems in that lesson. We offer a menu of twelve CATs so that instructor can choose specific ones that help students deal with particular types of assignment. For example, if an English professor has assigned a non-fiction essay to be read and wants to focus students' attention on the essay's theme, the professor can ask students to complete a "One Word Journal" CAT on the Web. That selection asks the student to choose one word that encapsulates the theme of that essay and explain the signigicance of that word in no more than 100 words. When the professor accesses his or her e-mail in the morning, the computer will deliver the students' journal entries, although the identities of the individual journalists remain hidden. Student anonymity is the key to the assessment process because it frees the student from the apprehension of getting the "correct" answer and focuses the instructor on the nature of the learning rather than the task of grading.

Moreover, use of these CATs promotes metacognition among students. The physics student who is asked to identify the "muddiest point" in the reading assignment or the calculus student who is asked to apply a specific concept to a real world situation are improving their "learning strategies and study habits in order to become more independent, successful learners" (Angelo, 1991). And by planning the class session as response to assessment of student learning, instructors develop a more student-centered instructional environment. For example, one of our physics instructors reports on using "mud2," one of our "muddiest point" choices with his cadets:

> I used the mud2 with the intent of getting feedback on the next lesson [that evening's reading assignment] but instead got feedback on the last couple lessons. The feedback told me to go back and clarify some cadet misconceptions I thought were clear.

We know from discussions with nationally known educators that our feedback systems, while simple technically, offer a rich resource for improving student--and faculty--learning.

References

Angelo, T.A. (1991). *Classroom Research: Early Lessons from Success.* San Francisco: Jossey-Bass.

Angelo, T.A. and Cross, K.P. (1993) *Classroom Assessment Techniques: A Handbook for College Teachers.* San Francisco: Jossey-Bass.

Cross, K.P.(1996) Teaching and learning for the twenty-first century. Keynote address at conference for federal service academies, West Point, New York, September 1996.

Gerstman. B.B. (1995) Student evaluations of teaching effectiveness: the interpretations of observational data and the principle of faute de mieux. *Journal of Excellence in College Teaching.* 6, 115-124.

Menges, R.J. and Rando, W.C. (1998). Feedback for enhanced teaching and learning. *Teaching on Solid Ground: Using Scholarship to Improve Practice*, ed. R.J. Menges, M. Weimer and associates. San Francisco: Jossey-Bass. 233-255.

Shulman, L.S. (1988) A union of insufficiiencies: strategies for teacher assessment in a period of educational reform. *Educational Leadership.* 46, 36-41.

Upcraft, M.L.(1998). Teaching and today's college students. *Teaching on Solid Ground: Using Scholarship to Improve Practice.* 21-41.

Using SGML to Prepare Secondary School Distance Education Courses for Internet and Traditional Delivery

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Abstract: This paper describes the beginning of the OSCAR (Open School Courses and Resources) program: a multi-year project to create a high school graduation program that uses SGML (Structured Generalized Markup Language) and XML (Extensible Markup Language) to create courses with:

- Time- and place-independent or classroom learning.
- Content modularity permitting the repurposing of content
- Presentation to the student either with or without computer technology (one course, several options for delivery)
- Enforcement of good instructional design and planning

This paper describes the origins of the project, pilot efforts that guided it, and some of its rationale. At the time of writing, the first student registrations are still eight weeks away. When the paper is presented, initial teacher and student reception of these courses will be described.

Introduction

Open School and its Distance Education Work

Now in their eightieth year, Open School and its predecessors have been the primary provider of distance learning for the public school system (Kindergarten through Grade 12) in the province of British Columbia, Canada. Open School originated, much as Australia's School of the Air originated, to meet the educational needs of children in the province's vast hinterland. Since 1980 its distance teaching or delivery function has been regionalized; Open School develops courses that are for the most part delivered through nine public schools that specialize in distance learning. More recently, Open School moved from being an internal branch of the province's Ministry of Education and is now a division of the Open Learning Agency of B.C., a 25-year-old institution of distance learning for post-secondary students and the workplace. Open School is thus the K-12 division of the Open Learning Agency; however, it continues to operate as a partner to public schools rather than as a school itself. Open School develops distance learning courses that align with the province's curriculum standards, and sells them to schools. About 21,000 school students take 47,000 Open School courses each year, the majority at the secondary level.

The Shifting Demands for School-Age Distance Education

The increasingly widespread Internet has opened new pathways for delivering Distance Education, and consequently a demand for courseware that exploits the medium. Research that demonstrates improved distance learning at the *secondary* level via the Internet is still sparse, but the medium's ability to reduce the Kearsley calls the "transactional distance" between the student and instructor holds promise for—and this is *the* crucial factor for youthful distance learners at the secondary level—motivating the students to complete their coursework successfully.

Two pilot projects reinforced Open School's optimism about the success of technology-mediated distance learning in the upper years of secondary school.

Between 1993 and 1998, Open School and its public school partners enrolled several hundred secondary students in "New Directions in Distance Learning" (NDDL). This program consisted of 25 Grade 11 and 12 courses which used synchronous and asynchronous delivery at a distance—computers with connectivity, audioconferences with instructors and fellow students, and other modalities such as print. Students in NDDL achieved a near-doubling of successful course completions compared to distance learners in the print-based equivalent courses, and equal course standings [McCauley, 1996]. NDDL demonstrated that technology-assisted learning is effective in the secondary setting. It also showed that synchronous sessions are generally not viable as part of the public school setting, and that with centrally managed mediation, it takes time to achieve economies of scale.

Since 1997, Open School's nine Distance Education (DE) School partners have successfully piloted another, asynchronous, technology-mediated CONNECT program, in the middle school grades. Students borrow computers from the DE School for use at home. They use email and the Web (and sometimes phone calls, but generally not conference calls or other synchronous media) for their connectivity with teachers and the school. About two thousand students have participated in the CONNECT program to date; educational results, though not yet rigorously compared to equivalent distance learners outside the program, are anecdotally very positive. This program is no more costly than classroom-based instruction, so economic viability is just another issue to manage alongside the others.

Open School's distance education products, though not designed specifically for the classroom, also find modest but steady use there. Apparently, courseware with enough student guidance built in for successful self-study also benefits some students in the classroom. This is especially true if the DE courseware is designed to incorporate technology, and the classroom has technology which needs course content. A key reason for Open School to leave government and become part of the Open Learning Agency was to address this classroom audience.

In summary, there is increasing demand in public schools for technology-mediated distance learning resources, both in the traditional DE community (insofar as it exists) and in the classroom. Their utility has been demonstrated, and occasionally measured, but there are constraints.

Constraints on Technology-Mediated Courses in Senior Secondary Schools

Besides the well-known problems of inadequate teacher preparation and erratic technology infrastructure, other aspects of the B.C. public school environment can reduce the effectiveness of courses that rely on technology:

1. In the final years of high school, the pedagogy is trending towards higher-level learning skills such as synthesis, reasoned conclusions, portfolio building, and problem solving. B.C.'s Grade 11/12 program has shifted decisively towards higher level learning, and also towards outcomes-based learning wherein teachers are to assess students' ability to perform those higher level skills. Commercial computer-based courseware does not always follow that trend; it is much less expensive to design and assess "factoid learning"[1].
2. A cardinal tenet of B.C. public education is equality of access for all. Accordingly, any courseware that relies on technology to meet the provincial requirements, would benefit (politically as well as in practice) from offering an equivalent stream which meets the same outcomes without needing technology. Dual offerings also allow a teacher to switch students away from technology, yet stay on track in the course, when the school's system is unavailable or the classroom has too few computers.

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[1] For example, commercial algebra software tends to teach students to discriminate between a monomial and a binomial, or to state the definitions of tangents, rays, and congruency. This is lower-level, memorize-and-repeat learning that is easy to teach and assess by computer. By contrast, Ministry-prescribed learning outcomes for B.C. algebra students do not require the students to state any definitions and in fact discourage such practice; instead, the emphasis is on their ability to solve open-ended problems which require them to correctly *choose and use* binomials, or tangent properties, or congruency. It is much more of a challenge to facilitate that type of higher level learning via technology, since *how* the student arrives at the correct answer is what must be taught and evaluated.

3. Another cardinal tenet is universality of access. In practice, access to senior elective courses varies profoundly from one school to the next. Unless a B.C. school can muster 15 students for a course, the Ministry generally cannot provide funding to the school to provide the instruction. Many B.C. students enroll in DE because their public school does not provide the course they want. By bringing distance education courses into their classrooms, *some* teachers could manage dual-course or triple-course classrooms if the courseware met all required outcomes while not requiring constant delivery from the teacher.

4. Finally, the 'market' for senior-level courses is dispersed and costly to address: computer-assisted courseware is costly to develop and public schools have severely limited budgets. This combination of constraints means that senior level courseware needs to be developed in a systematic way, allow for a variety of presentation media without doubling the development effort, and insofar as possible, make use of pre-existing distance learning content.

At the confluence of these demands and constraints Open School chose to adopt a course development system for the senior secondary grades that is based on Structured Generalized Markup Language (SGML) and its Web-oriented derivative, Extensible Markup Language (XML). Courses designed this way bear the acronym "OSCAR" (Open School Courses and Resources). In the next section, after briefly explaining SGML and XML concepts, explains how the SGML/XML approach addresses the above constraints on senior secondary learning.

The SGML/XML Model for OSCAR Distance Learning Course Development

A Brief Explanation[†] of SGML and XML

Both SGML and XML have the goal of storing human-readable documents such that computerized systems can discern, and thus properly render, their content. SGML is a standard way to describe a document via user-defined and machine-readable markup tags; the publishing industry has used it for a number of years. XML is a more recent subset of the SGML specification for use on the World Wide Web. They are compared to the more familiar HTML in Table 1.

A memo header using HTML	A memo header using SGML or XML
<Bold><Center>**Corporate Name, Inc.**</Bold>	<Logo>**Corporate Name, Inc.**</Logo>
<Bold>**To:**</Bold> <Bold>**From:**</Bold> <Bold>**Date:**</Bold>	<To>**To:<**To-names> </ To-names></To> <From>**From:**</From> <Memodate>**Date:**</Memodate>
<Bold>**Subject:**</Bold>	<Memosubj>**Subject:**</Memosubj>

Table 1: Contrast between HTML and SGML/XML when encoding (marking up) the same text.

The HTML version uses *procedural* markup to ensure that the memo header employs a bold font when displayed. Therefore, all the elements are bounded by <bold> tags. By contrast, the SGML version uses *descriptive* markup; each element in the header sports a different set of tags, and these tags describe the content inside the element instead of how to print it.

Descriptive markup allows both media independence and multiple media presentation. The SGML memo header could, for example, be rendered on paper (by a translator program) in a crisp, black sans-serif font; for a Web browser, a different translator program could render it in a larger serif font, and in dark brown against a cream background. The versions for the visually impaired would use a larger font still. However, there is *only one source document* behind all rendered versions.

[†] This is a necessarily sparse definition of SGML. A good starting point for more information is www.oasis-open.org/cover/sgml-xml.html, and its links under "General Introduction to SGML." The Arbortext link there is a good starting place for the SGML beginner. For XML, see also Bosak and Bray (1999).

The user-defined elements are collected into an Element Dictionary (ED) and matched with a Document Type Definition (DTD) that specifies which elements are allowed in which parts of a document. In courseware, this facilitates:

- the creation of courses from instructional design to delivery
- a higher level of content quality, by requiring that course planning stages be recorded in the obligatory "planning information" elements.
- the creation of assessment types and mechanisms, including assessments for higher level learning
- the identification, association, and categorization of resources within the course architecture
- the creation of custom views of materials for different types of learners
- the storage and management of parts and pieces of course materials
- the creation of a user-defined catalog of the parts and pieces of courses, thus having many "learning objects" available for the digital economy.
- the output to both print and web, as well as to other media, from one base document.

The Markup Language of OSCAR courses

Input from instructional designers, writers, managers and teachers resulted in an SGML-based Element Dictionary (ED) containing hundreds of elements of use to secondary-level course developers, like <section>, <lesson>, <assessment.type>, <equation>, and so on.

To show briefly how this SGML-based schema or course meta-language addresses the higher level learning and assessment which constrains secondary public education, consider these elements from the OSCAR Element Dictionary: <rubric>, <exemplar>, <givens>, <scenario>, <action>. Educators will recognize those as ingredients of criterion-referenced assessment, applicable to higher-level learning activities like portfolio construction or participation in on-line debates. The DTD for OSCAR courses permits the use of these elements (once only) whenever the course assigns a <long.constructed> or <collaborative> type of student assignment. If used, those elements will appear in both the student and the instructor versions of the course, as a table of criteria by which student work on that assignment will be marked. Criterion-reference tables can be large, so the table that appears in the Web version will be formatted differently from the one in the print version, to better fit an 800x600 screen. But the table's content—all that lies between the tags—remains the same for both.

The SGML/XML schema also assists universality and equality of access, since it allows the same original content to be rendered in more than one medium as appropriate. The original learning outcomes are retained for all the output formats, so technology-poor students can access an appropriate version of the content, and achieve the same learning outcomes, as technology-rich students.

Finally, by reducing some of the content-repurposing process to simple machine translation of tags, the SGML/XML model reduces the economic constraints of multimedia course presentation. Put another way, the SGML schema enforces more course planning "up front" and facilitates more content customizing later.

Implementing the SGML model

With studied understatement, *Scientific American* summed up the creation of a set of XML tags this way:

> Of course, it is not quite that simple. XML does allow anyone to design a new, custom-built language, but designing good languages is a challenge that should not be undertaken lightly. And the design is just the beginning: the meanings of your tags are not going to be obvious to other people unless you write some prose to explain them, nor to computers unless you write some software to process them. [Bosak and Bray, 1999]

Open School selected 14 courses [Table 2] for conversion or creation in the SGML model, and "grew" its ED and DTD on the basis of what went into these courses.

- Career and Personal Planning 11/12
- Chemistry 11
- English 11
- English 12
- Entrepreneurship 12
- Film and Television Production 11
- History of Film 12
- Information Technology 11
- Information Technology 12
- Journalism 12
- Law 12
- Visual/Media Arts 11
- Math 11 (Algebra)
- Social Studies 11

Table 2: Courses in the first year of the OSCAR program (numbers indicate grade level)

These courses represent an academic Grade 12 diploma with a major in applied visual arts; most students would choose a few of them as needed for their own academic program. Ten of these courses represent re-purposing of existing print courses into the SGML format; the others have been newly written using SGML. Course development began in 1998 for introduction to the school system in September 1999. Open School's research department put together the ED and DTD; a team of about 25 Open School employees and contractors applied them to the 14 courses, and designed Web user interfaces, databases and print translators to render the resulting courseware.

Open School also posited two learner profiles [Table 3] for most of the courses. The intention is that more learner profiles may be added later, and special activities tagged for them.

Learner Characteristic	Learner Profile 1	Learner Profile 2
Demographics	Age 16-18; could be adult; seeking secondary school credit to B.C. standards. May be studying in a classroom, or at home but still part of a school system.	
Connectivity via technology	None; mail (two way) or fax (one way) is used.	28.8Kbps or higher modem; email account; Web browser version 4 or above.
Instructional media	Primarily print; audio cassette player is available; VCR and word processor are optional, will not be available to all students.	Web, email, and word processor are readily available to student. Print may also be used. VCR is optional. On line asynchronous conferences available, at teacher discretion.
Instructional feedback and support	Available via mail and perhaps by phone, but not much needed.	Available via email or in class, so more accessible and immediate.

Table 3: Two learner profiles that operationally define the OSCAR course "audience".

One lesson we learned early was that one cannot simply apply education-oriented tags to a group of existing courses "as printed", not even to good courses designed for distance learning by the target audience. We found that the tags appropriate for one course would not fit another. The universal elements of educational material, suitable for defining and tagging in SGML, lie more in the instructional design steps that are invoked to meet learner profiles when the course is first written, but then discarded. Thus it became necessary to "rebuild" each course with forms and constructs that fit the DTD and the two learner profiles; the result was (in general) neither better nor worse pedagogically, but it was different and so entailed re-writing. Naturally, the new courses could be designed right in the OSCAR DTD so this misfit did not occur.

We also learned that Bosak and Bray's admonition "the meanings of your tags are not going to be obvious to other people unless you write some prose to explain them" deserves much thought and planning. Open School actually created a *second* ED and DTD for internal use, containing tags like <element.name>, <rationale>, and <user.info>. Its purpose is to prepare documents that teach internal staff how to apply the main schema!

Educators know that amenability to on-line instruction (for Learner Profile 2) varies strongly with the subject matter or course content. The courses reflect the range of suitability:

- Information Technology 11 and 12 are delivered almost entirely on line, and in fact lack a Learner Profile 1 (no connectivity) version.
- At the other extreme, Mathematics 11 uses video clips on CD-ROM but otherwise makes little use of the computer; the student does all work by hand on paper and hands it or mails it in. This is necessary because the prescribed learning outcomes for Math 11 in B.C. *all* require symbolic manipulation skills which are frustrating to execute on a computer, but easy to perform with pencil and paper. Providing enough specialized algebra software to meet even a few of the learning outcomes is too costly for the DE scenario where the student works alone at home. Therefore, the "on line version" or Learner Profile 2 version of Math 11 relies heavily on print resources, and student work is done by hand.
- The remaining courses lie between these extremes, being available in both technology-enabled and print-enabled versions that maximize the advantages of their respective media for two learner profiles. These are the courses that most benefit from their basis in SGML: one course, multiple presentations. The key point is that any version uses *the most appropriate* media for its content, its outcomes, and the resources of its learners. If some parts of an on-line course appear in print, there is good pedagogical reason.

Conclusion (sort of)

At the time of writing, one course in the OSCAR program (Info Technology 11) has finished its second year of classroom and DE use; the remaining courses are being readied for their inaugural use in September 1999. 150 B.C. educators have registered for the three day OSCAR training session in August 1999. This dual-mode courseware is receiving considerable interest in the B.C. public school system, since it is seen as a meeting point between the province's challenging requirements for graduation on the one hand, and the educational wave of the future on the other. For Open School, OSCAR represents a new use of SGML technology which (if successful) will be adopted by the rest of the Open Learning Agency for course development. Extensive field evaluation is the next step for OSCAR.

References

Bosak, Jon, and Tim Bray: "XML and the Second-Generation Web". *Scientific American*, May 1999. Also available at www.sciam.com .

McCauley, Enid (ed): *New Directions in Distance Learning: A Year in Review.* Vancouver: Open Learning Agency, 1996.

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An Approach to Distributed Functionality
The Smart Data Server

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Abstract: This paper introduces a new kind of Java-server, the Smart Data Server (SDS). It offers the accessing of data with function-calls to SDS-networks. This allows the building of lean clients with the shifting of functionality to the SDS-network. The server builds the middle-tier in a multi-tier architecture (Client - SDS-Network - Database). It offers a frame for easy-to-build environment-independent SDS-modules with multiple functionality. It is modular and easily scalable for different kinds of requirement.

1. Introduction

The Internet has witnessed some major steps of evolution in its history. The biggest step was carried out with the introduction of the World Wide Web (WWW). To access data via the WWW, a web browser asks an HTTP server for a document. This document may either be a static document that never changes its contends or may be generated dynamically, using CGI-Scripts. With CGI a user can transfer data to the server. The server uses CGI programs to manage the data and to produce the document displayed by the web browser. There are no restrictions towards CGI-programs. With the possibility for CGI programs to access databases, HTTP servers became the middle tier in a three tier architecture. Compared with the user-interface of native applications in a windows-based environment, the database access for users over the internet was very limited though. This changed with the introduction of Java and their applets.

Apart from the known advantages of Java-applets (running everywhere, offering a graphical user interface, running in the sandbox of the browsers), one other advantage of Java-applets is the possibility to open network-connections to the computer they were loaded from [Sridharan 97][Farley 98]. Thus, it is possible for Java-applets to access databases without any help from the HTTP server. But this is a two-tier communication with the known security problems [Dickmann 95].

Placing a database on the same computer as the HTTP server means placing the database in the internet. But data with some value should not be placed on a computer with direct access to the internet. There is no guaranty for the data not to be manipulated by hackers. This shows the need for Java-applets to access the data via a three-tier architecture with an (possibly insecure) middle-tier and a hidden database server.

Java-applets should be kept small to reduce the loading time over the internet. Thus, applets need to be generated as graphical user interfaces. The clever calculations have to be done on the server-side using function-calls. Because the functions operate on data and the data is sometimes placed on different databases with different access-restrictions, the need of function-routing is obvious.

Finally, there is a structural problem. To develop the middle-tier in a three-tier-architecture, one has to be aware of the possibility that the environment the middle-tier is placed in sometimes changes during the lifetime of the middle-tier. Therefore, the solving of a problem should be separated from the environment the middle-tier is placed in.

In this paper we introduce a new Java-server, called the Smart Data Server, SDS:

- It offers the accessing of data with function-calls to SDS-networks. This allows the building of lean clients with the shifting of functionality to the SDS-network.
- The SDS acts as the middle-tier in a multi-tier architecture (Client - SDS-Network - Database) so that secure access of data is guarenteed [Fig. 1].
- It offers a frame for easy-to-build environment-independent modules with multiple functionality.
- It is modular and easily scalable for different kinds of requirement.

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First we will explain the main structure of the SDS with a short explanation of additional components. Then we will take a look at the configuration-file of the SDS and we will see how function-modules are registered to the SDS. We will show the data-structure which is exchanged between the clients and the modules of the SDS. The paper ends with a short conclusion with an outlook on the future of the SDS and the work related to it.

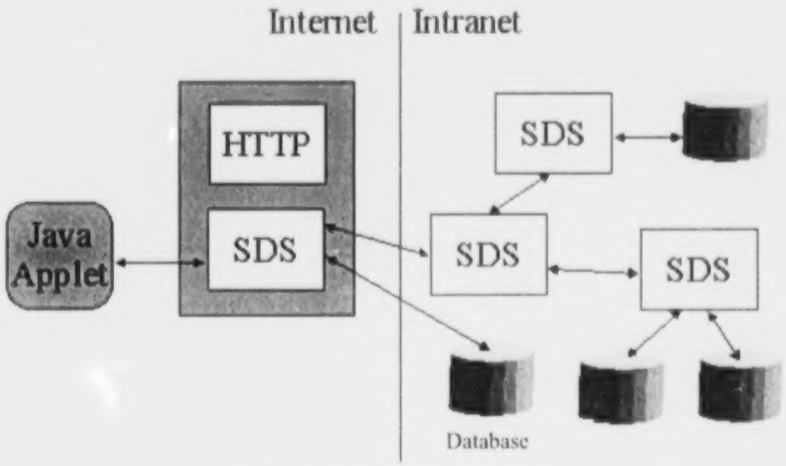
Internet
Intranet
HTTP
SDS
Java Applet
SDS
SDS
SDS
SDS
Database

Figure 1: The SDS as a multi-tier

2. The Components

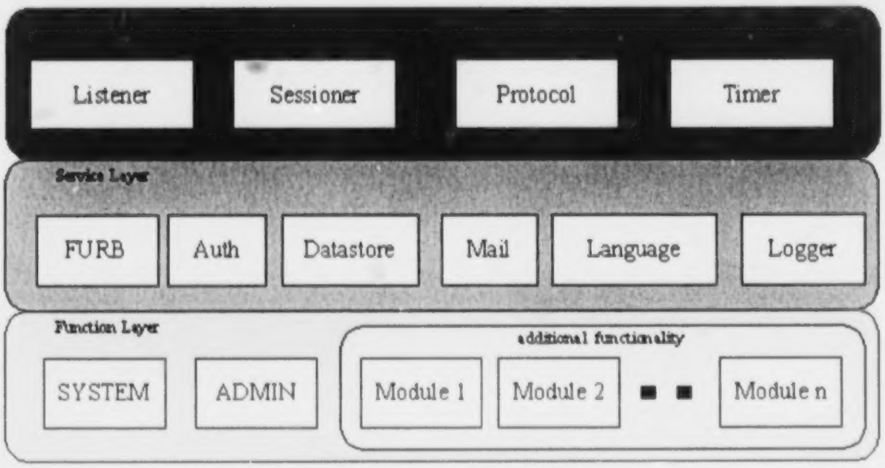
Listener
Sessioner
Protocol
Timer
Service Layer
FURB
Auth
Datastore
Mail
Language
Logger
Function Layer
additional functionality
SYSTEM
ADMIN
Module 1
Module 2
Module n

Figure 2: The structure of the SDS

The SDS is a server, written in Java. The core management of handling server-sockets is very similar to the way every Java-Server handles this process. The *Listener* of the *Session Layer* is a module waiting for communication in a defined protocol on a defined TCP-port. One or more Listeners can be defined, each with different protocols. After a client has connected to the port, the Listeners creates a *Sessioner*-Thread, depending on the type of the protocol. In our existing implementation of the server there is one specific Sessioner-module and one protocol defined module (IPTP = Information Package Transfer Protocol). Implementations of further

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protocols can easily be added to the server. In this paper we will only give an overview of the protocol. To describe the implementation process would go beyond the scope of the paper.

First, the Sessioner-module asks the *Protocol*-module to read the request of the client. The IPTP-protocol itself is divided in a header and a body. The body holds the definition of the request, while the header holds information about:

- Which function-module has to answer the request?
- Who wants to access this function-module?
- Is this request part of a user-session (not a network-session), and which session is it?
- What type of body will follow?
- How is the body encrypted?

This catalogue reminds one a little of HTTP and the way it is implemented looks like HTTP as well but the aim of HTTP differs from our protocol in general. HTTP (as the name "Hyper Text Transfer Protocol" shows) is a protocol to access Hyper Text documents. Our protocol wants to transfer function-requests.

The module-name is part of the header because the decision which function-module has to be called takes place at a higher level. The decryption of the body on the other hand is the job of the modules themselves.

With the information of the header and the knowledge of the IP-Number of the client, the Sessioner decides whether the requests contradict any authorization-restrictions. This decision is supported by a module of the *Service-Layer*: The *Auth*-module. If nothing contradicts the request, the Sessioner asks the *FURB*-module (FUnction-Request-Broker) of the Service-Layer to handle the request. The FURB knows which function-modules are registered in the *Function-Layer* at the startup of the SDS. Dynamic registration of functions will be part of the future development of the SDS.

There are two ways to register a function-module to the SDS: Either as an internal module or as an external module. If the module is internal, the request is handled by the defined java-class. If the module is external the SDS knows which SDS in the SDS-network has to be asked to handle the request. In this case, the SDS acts like a client towards the second SDS. Without any change of the body, the request is transferred to the second SDS, and the result is transferred without any change to the original client. So the FURB is the main part of the SDS that allows the building of SDS-networks.

The FURB does not only manage requests from clients. It is also possible for each function-module to construct requests by itself and direct them to the FURB. The FURB makes no difference in managing requests from clients, from other SDS or from function-modules of the SDS itself.

This offers an interesting third way to register a function-module in the SDS: internal and at the same time external. In this case, the FURB tries to call up the internal function-module in the first place. Only if the function itself calls itself the function is routed externally to the function-module on the second SDS.

A different kind of request is the timer-based request. The *Timer*-module of the Session-Layer can ask for a specific function-module at a defined time or after a defined period of time. These requests produce no answers. Timer-requests result in side-effects of the function-call. To give an example: Session-based request of modules may read data from a database while timer-based request cleans the database once a night.

To make the function-modules easy-to-build, it is necessary to make them independent of the environment that the server is placed in. One part of the environment are databases. The *Datastore*-module allows to access a data-pool without any knowledge of the underlying protocol or name of the database-server. The configuration-file holds the concrete access-information of the database. The access of the Datastore-module is not connected to any knowledge of SQL-statements. In fact the request is transferred to standard-SQL but this is not transparent to the function modules. This makes a change of the underlying database easy without changing any line in the function-module. The *Mail*-module allows the transfer of mail to an SMTP-server or to read mail from a POP-Server. The *Language*-module transfers the body of a request into a Java-data-structure. This data-structure is explained in the [The Request]-section. The *Logging*-module allows the logging of information for each kind of module.

There are two function-modules that are part of every SDS and are not part of the additional functionality. The *SYSTEM*-module allows clients to open a user-session including a transmission of an account name and a password. As a result a user-session-id is transferred and the user is allowed to access every non-restricted function-module for the duration of the user-session. The *ADMIN*-module is responsible for creating and deleting user-accounts.

3. The Registration of Function-Modules in the SDS

We have to take a closer look at the configuration-file to understand how function-modules are registered in the SDS. The configuration-file is the place to configure each specific part of the server: It determines which modules are used, which protocols are understood by the server and how the database-server should be accessed. Most time the configuration results in an identifier, so that the modules only have to know the identifier to access the resource. This is the place where the environment of the SDS is described.

The configuration-file is loaded only at the startup of the server. Thus, dynamic registration of function-modules is not supported.

3.1 The FURB-Section

For each function-module there has to be an entry in this section, defining if the module is internal or external. For external modules it must be defined which SDS has to be accessed, and which protocol is to be used. The example shows the registration of two external modules "module1" and "module2", connected to the server "sds2" on port 1234 using the protocol "iptp":

- _job=load modules=module1,module2 external=yes url=sds2 port=1234 protocol=iptp_

Internal modules are defined by the implemented class. Here the module "system" is defined :

- _job=load module=system external=no path=ti.sds.server.module.function.system.System_

If the load of the server increases, it is easy to declare an internal function-module as external for the future. The relation of an external module to a known SDS remains static. For the future, a dynamic selection is planed.

3.2 The Timer-Section

Each module can not only be accessed via client-requests but also via timer-events. There are two kinds of timer-events. The first defines the time, that is when the event should happen (at-jobs):

- _job=at module=cron function=cleanup dayofweek=* month=* day=* hour=20 minute=17_

The second kind defines the period, that is when the event should happen again (every-job):

- _job=every module=cron2 function=rebuilt minutes=60_

3.3 The Auth-Section

This section defines additional limitation to access function-modules. While every module can only be accessed after having been authorized for the SDS, modules defined as "freeaccess" are free to be accessed without any authorization. The example shows that no registration is needed for the module "system":

- _job=freeaccess module=system_

Modules defined as "restricted" can only be accessed from computers with a defined IP-numbers, here the module "admin" can only be accessed from the 192.204.23.41 and 192.204.23.45.

- _job=restrictedaccess module=admin ip=192.204.23.41,192.204.23.45_

4. The Request

Until now, we have only seen how a function-module is placed in the structure of the SDS. In this section we will explain the structure of the request and the underlying data-structure. Every function-module receives the header and body of the protocol from the FURB. Depending on the encryption, the module has to decrypt the body first. Next, the data-structure has to be constructed using the Language-service. To transmit the result of the request, the data-structure has to be constructed and than it has to be coded using the Language-service. The data-structure "Struct" depends on three sub-structures: single elements (Java-String), lists (Java-Vector) and hashtables (Java-Hashtable) [Tab. 1].

A request and its results are, in the first place, hashtables. The hashtable keys of a request are "FUNCTION", "PARAMETERS", "DATA" and "RETURN". "FUNCTION" defines the function inside the module to be called.

While "PARAMETERS" defines the parameter of the function, "RETURN" defines which result is requested. The "DATA"-section is used if data is transferred to the SDS.

Struct ::= String | Vector | Hashtable
Vector ::= [Struct*]
Hasthable ::= { (String, Struct)* }

FunctionDef ::= ("FUNCTION", String)
ParametersDef ::= ("PARAMETERS", Hashtable)
DataDef ::= ("DATA", Hashtable)
ReturnDef ::= ("RETURN", Hashtable)
ResultDef ::= ("RESULT", Hasthable)

RequestDef ::= {FunctionDef, ParametersDef, DataDef, ReturnDef}
AnswerDef ::= {FunctionDef, ResultDef}

Table 1: The Data-Structur

Defining the "RETURN" section enables the function to calculate only the requested values. If no error occurs, every entry in the "RETURN" section has its corresponding entry in the "RESULT" section of the answer. The hashtables of "DATA", "RETURN", "RESULT" and "PARAMETER" are interpreted as pairs of variable names, that is the key of the hashtable, and its value.

To define the request-structure, the programmer has to know the signature of the function: the required parameter/data, the default-values of the optional parameter/data and the possible return-values. The client has to know which functions are possible.

5. Conclusion and Future Work

After all the technical descriptions of the SDS we have to take a look at the usability of the SDS. There are several aspects to describe the advantages of the SDS:

- Scalability: If the problem grows the SDS can grow too. It's no big thing to add new modules to the SDS. If too many calculations have to be made at the same time it is possible to built a SDS-network, each responsible for a different kind of problem to handle the burden of the SDS. Sometimes you only have to duplicate the SDS physically and make some minor changes in the configuration files.
- Modularity: The functionality is defined in independent modules. If the functionality has to be changed to solve a problem in a different way, only the module implementing the problem is affected. Problems can be split and implemented by different programmers independently. A programmer can focus on the main problems of the functions by defining the way a module has to be accessed, by deciding which functions have to be implemented, and by determining which resources the module can use (data-pool, mail, other modules, ...).
- Flexibility: The modules are independent of the data sources and data drain. Both can change without affecting the modules. The SDS is open to different kind of protocols or new services. If it is becoming necessary to implement other protocols (HTTP, FTP, SMTP, ...) or other service (encryption-service, gateway to CORBA resources, ...), the existing structure of the SDS is not affected. Those new core-modules can easily be added to the SDS by changing the configuration-file. Thus, the SDS can be customised if a different additional functionality needs different protocols or services.
- Reusability: The architecture is open to different kind of problems, whether for building a portfolio-management-system (like we did) or for implementing a weather-service or for solving other problems. This does not affect the core modules of the SDS.
- Complexity: The server is written in Java and uses the advantages of packages. The code of the server itself therefore can easily be read and understood. New developers don't spend much time in learning how to add new modules.
- Performance: The Server was tested in a small environment with about 10 persons. It runs with JDK1.1.7 on a Linux-computer. The responding time showed no significant difference in the number of persons accessing the server simultaneously.

The server is about 200kByte big without additional functionality. It uses the advantages of Java 1.1.

The development of the SDS is only at the beginning, however. In our future release we want to implement a bet[illegible] mechanism to route requests to other SDS. The static definition should be replaced by a dynamic one, depending on the load of the server or other indicators.

Another focus has to be put on the client. The client has to be as modular as the server to make it easy to build both of them simultaneously.

The first additional protocol we want to implement is the HTTP protocol and an HTML-service to allow the access of functionality without the use of Java applets.

The server at this point is a Java-Server. But the definition of the protocol makes it possible to change this decision in the future, if the performance should become a problem.

6. Related Work

The background of all this functionality is a database. This makes it easy to compare the SDS with stored procedure calls of databases, because both built complex functions on top of database-tables. One big advantage of the SDS is the independence of the underlying database. The service to access databases implemented in the SDS depends on standard SQL so that a change of the databases is possible. The restriction to standard SQL makes the implementation process a little hard sometimes. But you don't have to worry about the functionality of the SDS when the databases is updated or changed.

"Distributed functionality" sounds a little like distributed objects. Therefore the SDS has to be compared with CORBA (http://www.omg.org, http://www.corba.org/), DCOM [Brown 97] or Java's RMI [Sun 98]. But creating an object on a different computer with all its problems is something completely different from calling a function of a module on another computer. It is less complicated and therefore less code is needed to implement the functionality. The object-approach can also be seen by HORB (http://ring.etl.go.jp/openlab/horb/)[Duan 96], an object request broker by Satoshi Hirona written in Java, or by a Swift-Product (http://www.swift.de/) using the RMI of Java.

Remote Procedure Calls (RPC) [Srinivasan 95] are in some ways similar to the way a function is called up by the SDS but the development of functions for the SDS is a process that has to be done simultaneously with the development of the client. It's more like a service-platform for easy-to-built applets.

7. References

[Farley 98]
Farley, Jim (1998). *JAVA - Distributed Computing*, O'Reilly & Associates

[Sridharan 97]
Sridharan, Prashant (1997). *Advanced JAVA networking*, Prentice Hall

[Dickmann 95]
Dickmann, A. (1995). *Two-Tier Versus Three-Tier Apps.* Informationweek 533, 13/95, 74-80

[Brown 97]
Brown, Nat (1997). *Distributed Component Object Model Protocol -- DCOM/1.0*, Microsoft Corperation
http://msdn.microsoft.com/library/specs/distributedcomponentobjectmodelprotocoldcom10.htm

[Sun 98]
Sun Microsystems (1998). *Java Remote Method Invocation Specification, Revision 1.50, JDK 1.2*, Sun Microsystems
ftp://ftp.javasoft.com/docs/jdk1.2/rmi-spec-JDK1.2.pdf

[Duan 96]
Duan, Nick N. (1996). *Distributed database access in a corporate environment using Java*, Computer Network and ISDN Systems 28 (1996), 1149-1156

[Srinivasan 95]
Srinivasan, R. (1995). *rfc1831, RPC: Remote Procedure Call Protocol Specification Version 2*
http://www.cis.ohio-state.edu/htbin/rfc/rfc1831.html

HALPIN : A Natural Language Information Retrieval System For a Digital Library on the World Wide Web

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Abstract: Designing computers with the ability to talk and understand a natural language (NL) conversation is a major field of research. We have developed the HALPIN[1] system to implement our multimodal conversational model for information retrieval in a digital library via the World Wide Web. This dialogue-oriented interface allows access to INRIA's[2] database, on the Internet, in a natural language mode. The inputs from the user, could be either oral sentences or mouse/keyboard actions. The results of the first experiments show that the HALPIN system provides interesting dialogues, in particular with beginners. It gives oral responses via standard browsers, for a more natural human-machine interaction according to the user's goals and skills. This leads to successful information retrieval, while searches with the original user interface (traditional web form) failed.

1. Introduction

Retrieving relevant information on the World Wide Web is not an easy task. As [HARDIE 96] observed, while seeking a document, "*some are looking for the ocean and some others for a grain of sand*". Pitkow and Kehoe remarked that these difficulties have four possible origins: "*The main problem people report when using the web are : (a) slow network or connection speed (b) not being able to find particular pages, even after they have been found before (c) not being able to manage or organize retrieved information and (d) not being able to visualize where they have been.*" [PITKOW 96]. We believe that with the exception of the connection speed, the other problems are mainly related to human-machine interaction. In addition, according to Conklin [CONKLIN 87], the two most important problems related to information access through hypermedia interfaces are disorientation and cognitive overload. To attenuate these problems, our approach is to integrate "human skills" to the actual systems. Indeed, natural language interfaces excel in describing entities that are not currently displayed on the monitor. These strengths are exactly the weaknesses of direct manipulation interfaces, and conversely, the weaknesses of natural language interfaces (ambiguity, conceptual coverage, etc.) can be overcome by the strengths of direct manipulation [COHEN 92]. "*Direct manipulation and natural language seem to be very complementary modalities. It is therefore not surprising that a number of multimodal systems combine the two*" [CHEYER & JULIA 95]. With the growing number of Internet users, efforts to make computer interfaces that are more simple and natural become increasingly important. We think that multimodal and natural language solutions for the World Wide Web should help people to accomplish their tasks more effectively than with traditional tools. The lack of real human-machine dialog corpus, especially in French, leads us to propose a usable incremental system for the Web rather than "Wizard of Oz" experiments. In the following, we describe the modelling and implementation of our system, designed for an information retrieval task in a large digital library of the Web.

2. HALPIN system description

Our work is based on the results of the ORION project[3] which concerns new multimodal technologies for Web navigation and information research [ROUILLARD 97a], [ROUILLARD 97b]. The HALPIN system is an incremental one : after each connection period, the dialog files are analysed ; the missing or misunderstood vocabulary is added or modified. This way, the system can be improved with each new version. It uses Xerox's morphological tools [GAUSSIER & al. 97] to convert the user sentences to a canonical form which may be analysed more easily by the HALPIN concept detection module. Figure 1 shows the interface of the HALPIN system for an information retrieval task on the World Wide Web.

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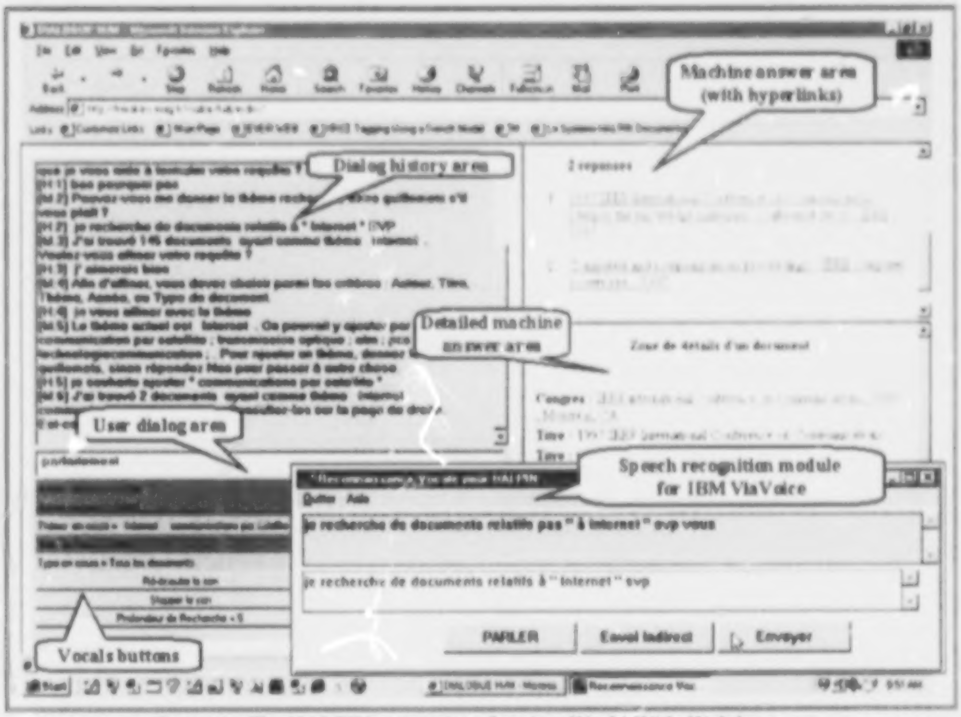
[1] Hyperdialogue avec un Agent en Langage Proche de l'Interaction Naturelle

[2] Institut National de Recherche en Informatique et Automatique (83297 documents available)

[3] http://www.gate.cnrs.fr/~zeiliger/Orion99.doc

2.1. Dialog manager cooperative model

There has been a great deal of research on information retrieval, but very little in which the NL plays an important role on the Web. Most of the classical user interfaces and search engines try to improve the efficiency of the search task with better indexing and retrieval methods. In such models, the human-machine interaction is limited to exchanges of the type: query => database access => reply. As information seeking and retrieval are interactive processes, we believe (as do [BATEMAN, HAGEN & STEIN 95]) that providing a flexible and cooperative human-machine dialogue is a complementary means of improving information retrieval systems. Inspired by the works of Brun [BRUN 98], our dialog manager uses a two-step algorithm of concept recognition which leads to an understanding of the user's queries.



je recherche de documents relatifs pas " à internet " svp vous

je recherche de documents relatifs à " internet " svp

Figure 1 : The HALPIN system interface in a World Wide Web browser

An intelligent conversational system must be capable of adapting itself to the user's goals and capabilities, interpreting speech acts within the context and negotiating ambiguous information using a natural language interface [STEIN & al. 97]. In our previous papers, we have also shown that it is possible to gather interesting human-machine dialogues on the Web without using the Wizard of Oz strategy [ROUILLARD & CAELEN 98], [ROUILLARD 98]. Having in mind these important observations in order to show that NL dialogue systems may improve interaction quality, we proceeded to create an interactive search and navigation environment (HALPIN) to incorporate adaptability and conversational capabilities to an existing digital library information retrieval system. Our goal was to propose a system which not only responded to the user sentences, but also proposed related information (similar authors or keywords) depending on user needs. This is why at the beginning of the *hyperdialog* [ROUILLARD 99], with this system, we have to determine the user profile (novice or expert) and her aim. The COR (Conversational Roles) model of

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[STEIN & MAIER 95] proposed typical *Ideal* and *Alternative* dialogue sequences (cycles). For example, a dialogue between the information seeker A and the information provider B, can be formalised as :

Dialogue (A,B) ➔ request (A,B) + promise (B, A) + inform (B,A) + be-contented(A,B)
Dialogue (A,B) ➔ offer (B,A) + accept (A, B) + inform (B,A) + be-contented(A,B)

In the same way, our model is a kind of conversational roles and tactics (COR) model augmented with the knowledge about the user and her aims, so the model can react according to the user profile and the task in progress. We propose, for a finalized and cooperative defined task, to follow the rule:

[Profile]. [Goal]. [Speech Act]. [Concepts]. [Task] ➔ [Reply]. [Justification] [Suggestion].

A user profile (for instance novice or expert) is determined at the beginning of the session according to whether the user wants (or does not want) some help from the machine. This profile can change if the relevant elements are detected by the machine during a session. The goal of the user, which can be "finding an already known paper", "searching an unknown set of books", "discovering the site", etc., is also an important element used by the machine for the orientation of the dialogue. Speech acts and concepts are determined for each sentence given by the user. It is not only a keyword detection. For example, the concept recognition module is able to understand that "the man who wrote this book" has to be considered as the concept "the author", or that "why not" means "yes", which is not possible with a simple keyword matching. This method adds a robustness to the system in the understanding of some "imperfect" sentences given by the speech recognition module. For example, in Figure 1, we can see that the speech recognition module gave the sentence "H4 : Je vous affiner avec le thème" (I you refine with the theme) instead of "Je veux affiner avec le thème" (I want to refine with the theme). This is not really a problem for the dialog manager which understand the concept *Refinement (theme)* and which did not detect any negation in the sentence : the result of this analysis is a request to the digital library with the new criteria, that leads to the cooperative answer of the machine that proposed to the user some themes close to the first one (see M5 on Figure 1).

This way, the machine prepares a reply, a justification of this reply, and a cooperative suggestion if possible. The concepts database is divided into different files, according to the type of concepts. Indeed, certain concepts are common to all possible tasks (acceptance, refusal …) and others are specific to a particular task. If a sentence is ambiguous, even when the goal of the user is known, the system proposes alternatives choices. For example, this French sentence : "je veux un livre d'algèbre de Boole" can be interpreted in two different ways : either the user wants a book talking about Boolean algebra or the user wants a book written by Boole. In the digital library that we used on the World Wide Web (INRIA), the first interpretation (theme=Boolean algebra ; author=?) gives 100 responses, while the second (theme= algebra ; author=Boole) gives only 1 response. So, we think that, rather than searching the database with an uncertain query, it's better to resolve the ambiguity in a cooperative way. The dialogue manager allows not only entries related to the current task, but also about the interface (screen, sound, speech synthesis) and system responses (called meta-information). The system tries to understand, according to the context and found concepts, if the user is speaking about the task (ex "The author is Turing"), about the interface (ex "I can't see anything on this screen") or about the meta-information (ex "Why do you ask me that ?").

2.2. Speech synthesis and recognition on the World Wide Web

The HALPIN system was developed using C, Java, Html and Perl languages. The users can hear the system responses thanks to software (Elan Informatique speech engine[4]) installed on our Web server which synthesises textual responses to a specific audio file[5]. This file is sent to the browser, and then played by the Java applet. We believe that for speech recognition on the World Wide Web, two different solutions are possible : a remote or a local solution. The first one uses a speech recognition server, so the user does not have to have its personal speech recognition software. An application must be installed on the client machine to catch the user's voice. It can be done in a free hand way, by using the vocal energy level to determine the beginning and the end of the sentence. The sound is then sent to the server and an ASCII string is received as the answer by the client. The second possibility is that every user installs speech recognition software on her computer, connected to the HALPIN system browser window. Each method has advantages and drawbacks : for the user, the first solution is the cheapest, because no software is needed but it is also the slowest, because the voice have to travel on the Web to be recognised and interpreted. So the gain brought by the "natural interface" could be lost if the speech file takes too long to travel on the network. For the moment, we have implemented software that uses the IBM ViaVoice speech recognition. It's a push-to-talk solution that will shortly be replaced by a free hand tool.

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[4] http://www.elan.fr

[5] Sun Java/Web format : 8000 Hz, 8 bits for our needs

3. First Results

We have tested our system with different types of users (novice, expert, with particular needs or not, etc.). Compared to the INRIA's traditional Web form, HALPIN gives some relevant information according to the needs and skills of the users. The following dialogues illustrate how the machine interacts with the user to determine her needs, asks her whether these have been met satisfactory and proposes alternatives when the results are not satisfying.

```
129.88.41.73 on Mozilla/4.0 (compatible; MSIE 4.01; Windows NT) the 18:1:99
15:20:44:M=What do you wish to do ? 1: Find a known document, 2: Seek a set of
documents, or 3: Discover this site?
15:20:44:H=1
15:21:05:M= Find a known document OK. Do you want me to help you to formulate your
request ?
15:22:38:H=yes
15:22:42:M=Do you know the name of the author of the document you are looking for ?
15:24:42:H=I believe that it is Krakoviak
15:24:56:M=I did not find a document with Krakoviak as the author. Do you want to modify
your request ?
15:25:06:H=okay
15:25:13:M=Make a choice among the criteria: Author, Title, Topic, Year, or Type of
document.
15:25:41:H=I would like to modify the name of the author please
15:25:55:M=Give me his name with a capital letter. You can also erase this author. Or do
you me to look for authors close to Krakoviak ?
15:26:38:H=hum, yes
15:27:56:M=The authors close to Krakoviak are krakowiak, sacha; krakauer, Lawrence ;
Give a new name or say No to move on.
15:28:46:H=Well, I will test with Krakowiak this time
15:29:04:M=I've found 15 documents with Krakowiak as author. Do you want to refine your
request ?
15:29:24:H=Of course
15:29:38:M=To refine, you must choose among the criteria: Author, Title, Topic, Year, or
Type of document (...)
```

Capture 1 : An example of cooperative and relevant human-machine dialogue with HALPIN

In Capture 1, the user says that she is looking for a document she already knows ; and she accepts a help given by the machine. She believes the name of the author is Krakoviak, but this name gives no answer. The machine asks for a modification of the query, and proposes to choose among : author, title, theme, year or type of document. The user chooses to work on the author's name, and the machine proposes some names close to Krakoviak. Finally, using the relevant name of the author (Krakowiak with a W), she finds 15 documents, and the dialogue continues to refine those results.

From a critical point of view, this dialog is not optimum because the machine should have offered the near matches in 15:24.56 already. The principle of cooperation according to the maxims of Grice [GRICE 75] states contributions to the conversation should correspond to the waiting time of the other interlocutors and according to the status report and goal of the conversation. For that, four maxims are retained: 1) Maxim of method: to be clear, avoid obscure expressions, to avoid ambiguity, to be concise and to be ordered. 2) Maxim of relevance: to be relevant. 3) Maxim of quality: not to say what you believe is false, not to say something for which you have insufficient evidence. 4) Maxim of quantity: to make the contribution informative, but not more than is necessary. As we will see later, access to the digital library is an important part of the time needed in the interaction. Searching for the authors close to the given one took, in our example, 1 minute and 18 seconds. If the user knows what the machine is doing during this time (as in our example), this latency is relatively acceptable. On the other hand, if the machine decides to be very relevant and do the same thing without informing the user, the problem of the extra time necessary for this operation could be a reason for the user to quit the dialog. The principle of transparency must be scrupulously respected : if the user knows what the machine is doing, length wait will be accepted more easily.

4. Statistical time evaluation of the system

A very important issue in the evaluation of a human-machine dialogue system available on the Web, is the time needed to reply to a user's sentence. In our system, there are four steps between the moment the user enters his statement in the dialog box and the moment he can hear and see the results. First, the sentence is sent through the Internet to the Xerox morphological tool. Then, the canonical form of this sentence is analysed by our concept recognition module in order to detect the important concepts to process. The third phase is a request to the INRIA's database accessible on the Web, and the last job of the system is to prepare a speech synthesis of the response and to send it to the Java applet client, with the hyperlinks and the textual information. In the following, we show some statistical analysis concerning the time needed for each module and the necessary time to provide a spoken interaction on the Web. We are not talking about the time needed for the speech recognition, because, at the moment, the module we are using is directly installed on the client machine, and connected to an IBM ViaVoice application; it is not therefore, possible to catch all these events from our server.

Time	Global	Xerox	% Xerox	Inria	% Inria	Elan	% Elan
Average	20.17	4.57	25.23	6.17	25.25	9.17	47.79
Standard deviation	6.12	0.67	7.83	3.40	14.40	4.94	12.23
Min	14.00	4.00	13.79	1.00	6.25	7.00	30.43
Max	32.00	6.00	37.50	11.00	47.83	19.00	65.52

Table 1 : Time statistics analysis of a man-machine interaction on the Web with the Halpin system

In our corpus, as we can see on Table 1 the average time needed for an entire interaction on the Web, from the moment the user validates his sentence till the moment he can hear the results, is 20.17 seconds. The morphological analysis represents 26 % of this time. The concept recognition is very quick (less than a ½ second and not mentioned on the figure). The access to the digital library is also 26 % of the time, and finally, the speech synthesis, with almost the half of the time, is the greediest module. In the case where there is no access to the database, the average time for a complete interaction is 12.36 seconds. It's about 45 % for the Xerox request and 55 % for the preparation of the speech.

5. Conclusion and future work

The HALPIN system is currently used by many people on the Web. The first results show that the users readily co-operate with the machine. This kind of multimodal natural language interaction is a valid answer to problems such as confusion, cognitive overload, and evaluation of the answer's relevancy. With the relative large number of real dialogs gathered on the Web by our system (more than 1000 files), we have a powerful tool for the study and development of a human-machine multimodal interaction model. We have shown that it is possible to dispatch through the Web a real time calculated speech synthesis, and we are now working on the integration of a voice recognition server module in our system. Some possibilities are currently being tested, such as the French "Janus system" [SCHULTZ 97] [AKBAR 98], in order to allow the user a free dialogue with the machine, in a more natural and effective way. We also count on the insertion of a large thesaurus, such as the French "Sémiographe" thesaurus from Memodata[6], for a broader cover of the vocabulary in input as well as output.

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[6] http://www.memodata.com/

6. References

[AKBAR 98] Akbar M., Caelen J. (1998). Parole et traduction automatique : le module de reconnaissance RAPHAEL, *COLLING-ACL'98*, Montreal (Quebec), 36-40.

[BATEMAN, HAGEN & STEIN 95] Bateman, J. A.; Hagen, E., & Stein A. (1995). Dialogue modeling for speech generation in multimodal information systems, in P. Dalsgaard, et al. (Ed.), *Proceedings of the ESCA Workshop on Spoken Dialogue Systems - Theories and Applications*. Aalborg, Denmark: ESCA/Aalborg University, 225-228.

[BRUN 98] Brun, C. (1998). A Terminology Finite-State Preprocessing for Computational LFG. *36th International meeting of the Association for Computational Linguistics & 17th International Conference on Computational Linguistics*, Montreal, Quebec, Canada.

[CHEYER & JULIA 95] Cheyer, A., and Julia, L. *(1995).* Multimodal maps : An agent-based approach in *Proc. of the International Conference on Cooperative Multimodal Communication (CMC/95)*, Eindhoven, The Netherlands.

[COHEN 92] Cohen, P. (1992) The role of natural language in a multimodal interface, *Proceedings of the UIST'92*, 143-149.

[CONKLIN 87] Conklin, J. (1987). Hypertext: an introduction and survey, *IEEE Computer*, 17-41.

[GAUSSIER & al. 97] Gaussier, E., Grefenstette, G., Schulze, M. (1997). Traitement du langage naturel et recherche d'informations : quelques expériences sur le français. *Premières Journées Scientifiques et Techniques du Réseau Francophone de l'Ingénierie de la Langue de l'AUPELF-UREF*, Avignon, France.

[GRICE 75] Grice H.P. (1975). Logic and conversation, in Cole, P., and Morgan, J.L., *Syntax and Semantic, volume 3, Speech Acts. Academic Press*, 41-58.

[HARDIE 96] Hardie, E. (1996). A grain of sand or the ocean ; User aims in search engine interactions. *Fifth International WWW Conference - Poster Proceedings*, INRIA/CNIT, Paris La Défense.

[PITKOW 96] Pitkow, J.E., and Kehoe, C.M. (1996). Emerging trends in the WWW user population. *Communications of the ACM 39,6*, 106-108.

[ROUILLARD 99] Rouillard, J. (1999). Les enjeux d'un dialogue Homme-Machine sur Internet - L'Hyperdialogue. *Bulletin d'informatique approfondie et applications, revue de l'université de Provence*, 52, France, 3-20.

[ROUILLARD 98] Rouillard, J. (1998). Hyperdialogue Homme-Machine sur le World Wide Web : Le système HALPIN, *ERGO'IA 98*, Biarritz, France, 343-345.

[ROUILLARD & CAELEN 98] Rouillard, J. et Caelen, J. (1998). Etude du dialogue Homme-Machine en langue naturelle sur le Web pour une recherche documentaire, *Deuxième Colloque International sur l'Apprentissage Personne-Système, CAPS'98*, Caen, France, 99-119.

[ROUILLARD 97a] Rouillard, J. et Caelen, J. (1997). Étude de la propagation au sein du Web à travers les liens hypertextes. *Quatrième conférence Internationale Hypertextes & Hypermédias*. Numéro spécial de la revue Hypertextes et Hypermédias, éditions Hermès, 1997, Paris, 87-100.

[ROUILLARD 97b] Rouillard, J. et Caelen, J. (1997). A multimodal browser to navigate and search information on the Web. *Fourteenth International Conference on Speech Processing (ICSP97)*, IEEE Korea Council, IEEE Korea signal processing society, Séoul, Korea.

[SCHULTZ 97] Schultz, T., Westphal, M., Waibel A. (1997). The GlobalPhone Project: Multilingual LVCSR with JANUS-3, *Multilingual Information Retrieval Dialogs: 2nd SQEL Workshop*, Plzen, Czech Republic, 20-27.

[STEIN & MAIER 95] Stein, A. & Maier, E. (1995). *Structuring collaborative information-seeking dialogues*, Knowledge-Based Systems, 8 *(2-3, Special Issue on Human-Computer Collaboration)*, 82-93.

[STEIN & al. 97] Stein, A., Gulla, J. A., Müller, A. & Thiel, U. (1997). Conversational interaction for semantic access to multimedia information, *in* M.T. Maybury (Ed.), *Intelligent Multimedia Information Retrieval*. Menlo Park, CA: AAAI/The MIT Press, 399-421.

Delivery of Computer Based Trades and Technology Training

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Abstract: Okanagan University College (OUC) is a comprehensive multi-campus post-secondary educational institution, which strives for excellence in teaching and student achievement. The Learning Centre for Computer Based Trades and Technology (CBTT), within the Faculty of Trades and Technology, uses educational technology to enhance education by blending the features of distance and campus based learning that highlights a commitment to accessible and affordable training.

CBTT uses distance, telecommunication and information technologies to unite the instructor and the learners with services that transcend barriers of time and place associated with traditional instruction. CBTT provides a quality educational experience built upon the model of live classroom demonstration. It gives the learners the opportunity to participate frequently or intermittently, full or part time, from home, institutions, community or workplace. In the past, these students had no way to access sophisticated course offerings unless they travelled to our main campus in Kelowna, which proved to be too costly in time and money for most. CBTT technology includes audio-conferencing, audio-graphics, and inter-active multi-point distribution software.

A live interactive link with Okanagan University College's KLO campus in Kelowna, BC will be established to demonstrate technology that is being used to distribute courses throughout Canada and the United States. Conference attendees will be encouraged to participate in an interactive session using audiographics, white board and a voice link.

Following this demonstration, attendees are invited to ask questions and discuss the feasibility of implementing similar programs at their institutions

1. Introduction

Okanagan University College (OUC) is a comprehensive multi-campus post-secondary educational institution, which strives for excellence in teaching and student achievement.

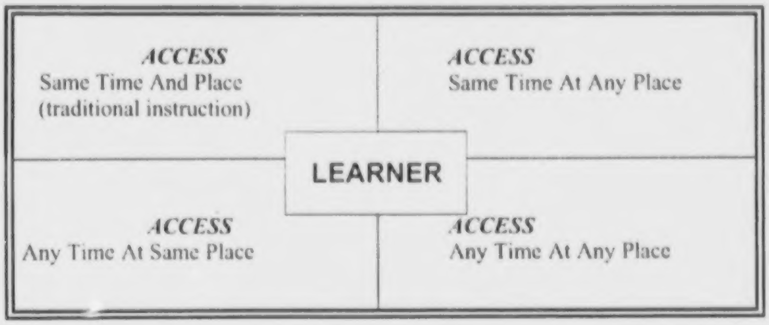
Our mission is to provide a comprehensive range of high quality learning opportunities primarily for adult residents of the Okanagan, Revelstoke, Shuswap and Similkameen regions in the Province of British Columbia. Due to this large geographical region the Faculty of Trades and Technology at OUC were faced with an enormous challenge of delivering trades and technology program offerings to all its ten campuses. We had to find a way to meet the needs of students in small communities where we could not offer traditional instruction on an economical basis. To meet these needs we developed a Learning Centre for Computer Based Trades and Technology (CBTT).

The learning culture of our society is forecasted to be significantly different in the coming years than at present. Learners of tomorrow will stand out for their proficiency in using technologies to access and successfully manage information and learning opportunities. They will expect a wide range and quality of opportunities and services, regardless of their location, and will have little tolerance for barriers to learning which are created by the system. A *virtual learning system* accommodates these changes.

Virtual learning systems use distance, telecommunication, and information technologies to unite the instructor and the learner with services that transcend barriers of time and place associated with traditional instruction.

It gives learners the opportunity to participate frequently or intermittently, full or part time, from home, institution, community, or workplace. The emerging learning culture shows growing evidence of demand for a different type of access to services. Access to training through technologies is viewed by a technically sophisticated public and the business community as essential to meeting accelerating demand and achieving cost effectiveness.

The dimension of time and place create four access windows to the learner: same time and same place, same time at any place, any time at same place, and any time and any place. The following chart illustrates the four windows of access, which are supported by a virtual learning system.



The majority of educational materials produced have traditionally been paper based, primarily to best serve the existing instructional methodologies. Historically this training has been provided through a same time and place (or face-to-face) classroom model of instruction and, to date, alternative approaches have not been viewed as viable. There are a variety of reasons for the disinclination to explore alternative methods. In some instances, no economic incentive has been provided to explore the options. As well, instructors' confidence in introducing other methodologies rests, in part, with administrative and organizational tradition.

Educational technologies however are giving us the opportunity to add value to traditional learning modes and, through the other three windows, increased access to educational services. A virtual learning system uses technologies to improve quality and access through all four windows.

The emergence of the Learning Centre for CBTT has tremendous potential to benefit students, employers, and the training system. In the past, these students had no way to access sophisticated course offerings unless they travelled to our main campus in Kelowna, which proved to be too costly in time and money for many.

Industry requires increasing access to relevant technical training and upgrading for its employees without sacrificing productivity. The increasing technology is reflected in longer technical training times that further exacerbates the dilemma of down time faced by the employers and employees. The use of CBTT significantly reduces the off-site training duration, in part, by producing workplace-training opportunities. This provides post-secondary instructors more time to reinforce upper-level psychomotor outcomes as opposed to more basic classroom theory; in effect, it allows the flexibility to redirect instructional resources for increased efficiency.

In the fall of 1994, OUC in collaboration with the University of Victoria and the Centre for Curriculum Transfer & Technology (British Columbia Government) completed the design and delivery of a pilot project in distance training. This project was designed to demonstrate how Trades Qualification (TQ) courses can be adapted for distance education delivery in a multi-campus institutional setting using audio-conferencing and audio-graphics technologies. Audio-graphics systems support visual learning and the combination of text, graphics, and audio-conferencing components can accommodate a variety of learning styles. The strengths of the audio-conferencing medium are the live group interaction and learner support. Such interaction enhances self-esteem and self-confidence and helps motivate adult learners.

Since the original pilot program in 1994, the CBTT Learning Centre has partnered with many institutions and communities across Canada and North America.

2. Case Study

Okanagan University College in partnership with the Office of Learning Technologies developed and delivered two trades-based upgrade courses using computer based information technology. A total of 22 students each received 60 hours of training in Automotive Service or Recreation Vehicle Repair. Students received instruction simultaneously across five provinces: British Columbia, Alberta, Saskatchewan, Manitoba and Ontario.

Academic success and student satisfaction was monitored regularly using various evaluation methodologies. In addition, a comprehensive evaluation was conducted at the conclusion of the two programs. Following are the key findings of this work:

- Students were particularly complimentary about issues of accessibility to this training. In many instances this was the only training available to the learner. The format and timing of the programs allowed for a maximization of access opportunities.
- Students adapted quickly to the technology they were required to use in their training. Some students expressed surprise at how simple the technology was to use.
- No difficulties were experienced with issues of inter-provincial accreditation. In the case of the RV training no inter-provincial standard exists at this time. If the training is a part of inter-provincial curriculum and is intended for purposes of accreditation, prior consultation with accrediting bodies is essential.
- Academic outcomes are consistent with the outcomes achieved using traditional delivery methodology.
- The cost of providing this training was consistent between provinces with the exception of long-distance telephone costs. Providing the training during non-peak rate periods can minimize these costs.
- Once established, the location of sites for the training did not influence the training itself. The set-up of home and business sites required more initial effort. Institutional sites were generally better equipped beforehand. The number of individuals per site/computer station should not exceed five persons if basic hardware is used. Good collegial co-operation was evident at sites with multiple participants. Protocol for conversation was established early in the training to provide equal opportunity for participation.

These programmes have served to augment OUC's experience base in the delivery of trades training at distance. The learning experienced by OUC has been, and will continue to be, well articulated to educators, government, business and industry.

Overall these programmes have been very successful and will undoubtedly provide the platform from which other successful initiatives are launched.

Okanagan University College recently received the Bellwether Award for Instructional Programs and Services. The Bellwether Award was created to acknowledge excellence and innovation in community college programming for institutes across North America, sponsored by the Institute of Higher Education at the University of Florida and the National Council of Instructional Administrators.

3. Panelists

a) Mike Schewe, Dean of Trades and Technology

The Dean's educational qualifications include an MA in Education specializing in curriculum development; professional trades qualifications of Master Automotive Technician, as well as a Canadian Interprovincial Red Seal designation. Prior to becoming the Dean, Mr. Schewe taught the four (4) levels of Provincial Apprenticeship, the Commercial Vehicle Inspection Program and the Private Vehicle Inspection Program. Mr. Schewe is currently the Dean of Trades and Technology at OUC and the President of the British Columbia Association of Vocational Administrators. He has been involved with the Fiji National Training Council with an International Training Project in Auto Mechanics. He also participated as a member of the Provincial Modularization Review Team in the assessment of the Provincial Automotive Apprenticeship curriculum, as well as a Writer for Years one (1) and two (2) of the new modularized Automotive Apprenticeship curriculum.

b) Randy Werger, Project Coordinator, Computer Based Trades and Technology
Mr. Werger's educational qualifications include a Provincial Instructor Diploma, a Technical Support for Business Certificate, a Carpentry Canadian Interprovincial Red Seal Certification, and a B.C. Steep Roofing Trades Qualification Certificate. Prior to becoming the CBTT Project Coordinator, Randy taught all four levels of Provincial Apprenticeship Training.
In Mr. Werger's capacity as the Project Coordinator for the delivery of Computer Based Trades and Technology training, he brings to the project a vast experience with PCs, local area network operations, wide area networks and distance learning technologies. He has solid knowledge of software including DOS, Windows 3.1, Windows 95 and related development software. His instructional background has prepared him well to assist in pedagogical issues. His demonstrated organizational and leadership abilities, combined with strong verbal and written communication skills, problem solving and supervisory skills, are invaluable to any project.

PANDA, a effective model of web based distance teaching and Learning Environment with integration of synchronous and asynchronous mechanism

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Abstract: This paper presents a model of a web based distance learning environment with integration of both the synchronous and asynchronous mechanism------ a virtual classroom where synchronous and asynchronous tools are provided to support the teaching and learning process based on web: (1) Web auto answer and analysis, which helps students ask questions and automatically get answers asynchronously in their studying process. More over, it can generate new questions to clients by question hooking, merging and analysis. (2) Web testing ,which simulates the traditional testing process during web learning . It provides a real time reliable examination on web supporting both the text and the multimedia testing. (3) Web discussion with real time audio supporting, which helps teacher and students exchanging ideas using multiple interactive ways, such as sharing white board, URL broadcasting and real time audio multicasting ,etc. We think the model provides a good resolution to the problem of establishing a efficient environment on web.

1. Introduction

With the development of Internet and Web technology, Distance Learning now becomes a hot spot in the network research and application. And the idea of global education on net shows people a brand-new prospect of modern education. How to create a efficient teaching and learning environment on net, especially on Internet is one of the key problems should be resolved . And lots of research work has been done on the mode of distance learning on Internet. However currently, most of the distance learning mode on Internet are based on static and single way self-pace courseware browsing. To get the effect learning, it is evidently not enough because learning is an interactive activity between teacher and student. Generally, traditional education model is based on a class-oriented environment, in which teacher and students stay in one classroom where all kinds of teaching and learning activities, such as questionning&answering ,discussion and examination are held. However in the view of global education on network, classes are no longer local classrooms ,on the contrary ,students can be distributed all over the world and teacher is in a remote place far from the students. Under such a circumstance ,"classroom" becomes a virtual concept ,but not a traditional physical space, for the teaching and learning activities. We conclude that in the general study mode, 3 segments are important. That is, questioning and answering, examination and group discussion. Those 3 activities could be divided into 2 different types: Synchronous activity(group discussion) and Asynchronous activity(questioning and answering, examination). To establish a efficient teaching and learning environment on Internet(A virtual classroom) , it is crucial to apply those 3 aspects into our distance learning model. In an other word, a virtual classroom on Internet has to provide accordingly both the synchronous and asynchronous tools for the above 3 activities. According to that, we designed the distance teaching and learning environment with integration of both synchronous and asynchronous mechanism as 3 parts: Web auto-answering and analysis, Web based examination and Web based group discussion.

2. Model of distance learning with integration of synchronous and asynchronous

mechanism.

2.1 Web auto-answering and analysis

Questioning and answering is a quite important segment in the teaching and learning process. In Internet based learning, there are perhaps thousands of students learning the same courseware. Because coursewares are usually classical , which means that in general there are specific knowledge points in one specific courseware. So it is most likely that you meet the same question as those learning the same courseware. Although the questioning and answering between the remote teacher and student can be via Email, however it is rather boring and inefficient for teachers to answer the same, or even the similar questions again and again. There must be an asynchronous mechanism to support question auto answering. An Answer Web is the system designed for that purpose. 2 aspects are available in the answer web:

1). Questioning and auto-answering

Generally each web based courseware to be studied is equipped with one correspond auto-answering machine backend. Student in the virtual classroom can visit answer web while they are studying the specific courseware to ask their questions and get the answers through the answer machine. Multiple means of ways of questioning are supported: plane text, audio and mixture of them. Also, students can snap the question background(such as a snapshot of one video stream on web) and submit it with the question to the answer web ,which makes teacher get more information when starts to answer the question.

Answer web will answer the text form questions from the student automatically by searching and matching answers in the backend question and answer database. The way of answer web "understands" the meaning of the question from the student is not based on the entire natural language understanding. Instead, it is based on multi-key words and syntax words matching. To each specific courseware, multiple key words are predefined by teacher. Because the natural human language understanding needs a large fundamental dictionary, rule database and the complex sentence analysis. It is difficult to implement and has not the efficient process speed needed in the distance learning environment. But multi-key words and syntax words matching is an easier way and in the specific courseware studying environment, it can also achieve satisfactory searching result because:

(a), one answer web is related seamlessly to one specific courseware, and the questions from students are usually limited in few knowledge points, so the answer set is limited. Answer searching is localized in the knowledge points of one courseware.

(b), to one courseware, its keywords are limited(such as the concept, definition and technical term),so it is feasible to index questions with keywords and group them according to their keywords.

(c), general syntax words are limited, such as "what", "how", "why" ,"difference" ,"concept" ,etc.

Since answer web supports both English and Chinese question auto answering, there is a syntax words table maintained in the system, as Figure 1

Key words flag	Field name	Field type	Field length	Description
*	C_SyntaxWord	Text	50	Chinese syntax words
	E_SyntaxWord	Text	50	English syntax words
	Synonym	Text	50	Chinese Synonym
	SyntaxID	Integer	8	Serial number

Figure 1. Syntax table structure

Syntax words and its synonym has the same serial number, so all the synonyms are linked and "Synonym" field stores the Chinese syntax words that has the smallest serial number in the synonym link. When syntax words are successfully matched, if it has Chinese synonym, system adds the "Synonym Field" into the syntax word string. If not, system adds the "C_SyntaxWord Field" into the syntax string. System regards the question with the same syntax string as the same question.

If an answer to a student's question is not found in the answer web database, system will notify the correspond teacher automatically. After the question is answered by a teacher, question and its answer will be stored into the database for the future searching. If another student asks the similar question, the answer will be found by key words and syntax words matching and returned to the student.

2).Question hooking ,merging and analysis

Besides feeding back answers to the client's question, answer web server will also "push" *questions to the client site by question hooking* and merging.

Answer web can not only search answers for a question from student, but also it can find out the relationships among the similar questions, generate a link among those questions and return the result link to the client. When a student asks a new question, he can observe its related questions and their answers. We call that a question hooking, which will help students get more information about one knowledge point to get full understanding .

With the adding of new questions and answers, the question and answer database will increase. Some questions on one knowledge point can be merged to generate a new question that no student ever has brought up. Answer web returns the new merged question to the student to help them deepen the understanding of a specific knowledge point.

When numbers of the stored questions are large enough, it is feasible to catalog them into different groups according to the key words and the knowledge points they belong to. Thus, when analysis results are returned to teachers, they can be used by teacher to evaluate their teaching effects. If there are too many questions on one knowledge point, mostly teacher should make emphases when teaching that knowledge .

Answer web gives students an auto- answering facility and by server site pushing technique, both students and teachers can make teaching and learning on web more efficient.

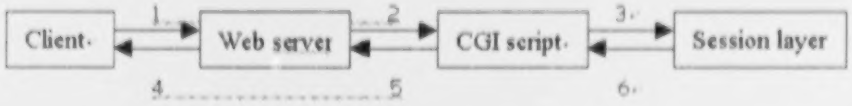
2.2 Web based examination

Examination is also a important segment in the learning process, so we also provide an asynchronous web testing system in our virtual class room model. 2 problems should be resolved in the designing. Since web is established on the stateless network protocol HTTP, while in a entire examination, we need to store information of each episode from registration, beginning of the test to the ending of the test. So we have to find a way to create a state sensitive application on the stateless connection. Besides, there should be a way to auto generate proper question sheet with the complexity control. And different types of question(such as multiple selection, blank filling and writing)should be supported along with the different media based questions (not only text based, but also audio and video based).

1). Using session to ensure the connection reliable

We use CGI script on the server site to add a session layer to the system. A session is process of examination from registration to quit . One unique session ID is assigned to each session .In every episode of the examination, a state is remembered using a state ID. A state conversion table is maintained in the system to indicate to which state one state can be converted . A unique session table is also maintained in the server site to store users' status, including Session ID, User ID ,State ID and other state parameters. On every interaction with the system, server checks the conversion table to confirm weather the state conversion is valid .If is invalid, the state conversion will be prohibited ,or if is valid, the conversion is carry out and new state ID is stored. Thus the operations of the users all under control of the server session. When testing is being processed , illegal operations will be projected by the server. If one student's examination breaks because of the breaking down of the network, its session will be stored on the server and when he log into the system again , server will recover the stored the session to continue last examination. A reliable examination thus can be held under the unreliable network environment.

Interaction between the client and server site is illustrated as Figure 2



1, interaction between user browser and the web examination system.

2,Web Server returns the user's result set the request to the CGI script.

3,CGI script calls the functionality of the session layer.

4,Session layer verifies the session and returns the result to CGI script .At the same time, it update the session table when session is legal.

5,CGI script returns the correspond information to the client according to the result from the session layer.

6,Web server returns the result page to the client's browser.

Figure 2. Interaction between the client and server site of web examination

2. Design of the testing question database

To make the generation of the question sheet efficiently, rapidly and randomly, multiple process are provided on the question database.

a), Add complexity parameter to each question and select proper questions to generate one question sheet according to their complexity parameter.

b),As to multiple selection ,separate the question and its correspond selection items to increase the randomization.

c),Generate a random question table by accessing the question database once at the beginning of the examination other than access database each time when user finishes answering one question.

d),Store both the question context and the user answer status in the question table to support the question overview.

2.3 Web based group discussion

Besides the asynchronous question auto answering and web based examination. We also provide a web base group discussion system with synchronous real time audio supporting. Students can not only study by static browsing ,but they can interact with teacher by means of media, such as text image and real time voice. Properties of web based group are as following:

1). Interactive.

Group discussion is by no means a one-way activity. In fact, students retrieve the educational material offered by the teacher ,at the same time, they feedback to the teacher so that teacher could adjust the process of teaching.

2). Multi-points real time audio supporting .

In addition to the text and image interactions, there should be more efficient way to support teaching and learning in group. Audio supporting is the best choice, which means the group discussion should support the real time audio interaction. In brief, voice of each end can be broadcast to the other ends in the same virtual group via Internet.

3). Tools provided for the teaching and learning activities in one group.

Robert M. Corderoy suggested that in on line education, "The methods which can be used are as varied as those used in any teaching and learning environment." Since group discussion includes both the teaching and learning activities, multiple tools should be provided to make an efficient discussion.

According to above, we construct the general model of web based group discussion as Figure 3

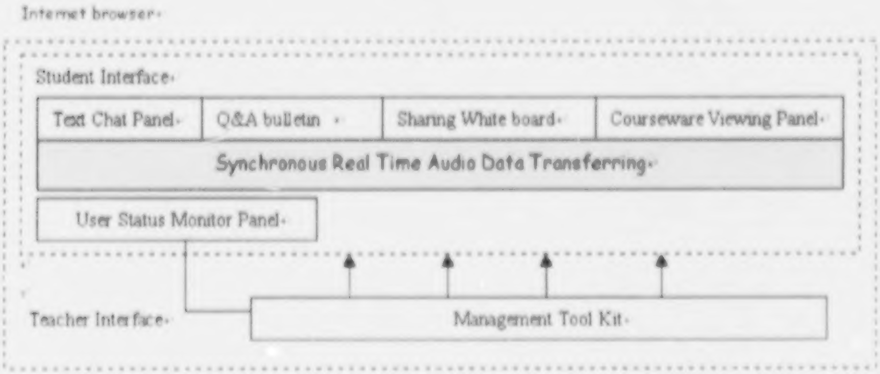


Figure 3. General model of web based group discussion

- *Text Chat Panel:* Text chat panel is a tool provided in the discussion group for purpose of text style intercourse . Just like other chat client in Internet, text chat panel support synchronous chatting ,including *private chatting*------student or teacher could choose a specific user in the virtual classroom as his partner to chat with ,and *public chatting*------every word one user typed can be shared by all the other users in the virtual classroom. Further more general text chat has been enhanced by the URL broadcasting . Teacher in one virtual classroom provide URLs linking to some helpful sites for study and can broadcast them to every student in the classroom that students can be guided by the teacher's navigating ,surfing in the Internet.
- *Question & Answer Past Panel:* Each student can past his question on this panel. Teacher and the other students can see the question when they login , and past their replies. Process of questioning and answering is asynchronous and in addition to the teacher's reply ,the others students can also publish their private answer to the question.
- *Sharing White Board:* Each teacher and student in the virtual classroom is sharing a white board

where they could not only past text but images . Also teacher could use drawing tools provided in the white board to sign marks freely on the image pasted on the white board in his teaching activity.

- *Courseware Tree-Viewing Panel :* In the virtual classroom , courseware are organized as a tree view list. Students can view the content of each chapter according to the tree view index with his Internet browser. Also teachers can make use of tree view index to past the pictures of the courseware onto the whiteboard for detailed discussion. At the same time teacher could control each student's browser window to show the specific chapter in the courseware. Thus, teacher could guide all the students studying the courseware in the virtual classroom just by navigating in his courseware viewing panel.
- *User Status Monitor Panel :* This panel list the status of the members in the virtual classroom, used by teacher for class management.
- *Synchronous Real Time Audio Transferring :* The virtual classroom we designed supports real time audio transferring synchronously. The voice data got from one site could be broadcast to each other sites in the one discussion group .Also ,teacher could grant or invoke speaking right to a specific student. Using real time audio can make question and answer activity synchronous.
- *Management Tool Kit :* Besides a courseware edit tool provided for teacher to create the courseware tree view list used in one virtual class. Management tools are provided for teacher to manage the whole group.

3. Conclusion and prospect

For the on line global education, it is crucial to create a efficient teaching and learning environment. Only using synchronous or asynchronous tools is far from enough in an efficient web based distance learning environment. We construct PANDA, a distance learning environment with integration of both synchronous and asynchronous mechanism and implement a prototype system------Distance Discussion System in our Web school (http://www.dlc.sjtu.edu.cn). The whole system includes most of the important episodes in teaching and learning: questioning and answering , examination and group discussion.

In the future work, we plan to do more research on CSCW and technology of virtual reality to improve our model and later construct a more effective teaching and learning environment on Web.

4. References:

[1] Shen Ruiming, Li wenbin, Yan jian. Web Testing ,a www based distance testing system. *Computer Engineering and Applications 1997-33-12*

[2]Shen Ruiming ,Zhu Qing .Distance Learning based on www---a mode and application. *Technical report of IEICE ,1998-12*

[3]Designing and Developing Effective Interactive Web Enviroments for Teaching and Learning. *Proceeding of ICCE'98,Vol 2,443-448*

[4] Chen Bin .The Design and Study on Interactive Distance-Learning System. *Proceeding of ICCE'98,Vol 2,515-516*

[5] Liu Kaiying, Guo bingyan. <<Natural language process>> ,1996.

EDI Transactions over the Web

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Abstract: EDI expedites the transfer of business documents and allows a business to contact more trading partners and get more competitive prices on purchases and sales. In this paper we address the need of small businesses interested in working with big businesses and government organizations that mandate the use of EDI. We are proposing an architecture that does not require a small business to maintain EDI specific software. A small business only needs a Java enabled Web browser to facilitate use of EDI transactions with big businesses and organizations. The key idea in our architecture is to use Java applets (downloaded by small businesses along with EDI messages) to process EDI messages. The traditional way of encoding EDI message is in ASCII format, however, we also explore the use of XML for encoding EDI messages. The tradeoff is that handling of XML based EDI transactions by XML-enabled browsers are relatively simpler.

1. Introduction

Use of EDI (Electronic Data Interchange) dates back to early to expedite the exchange of business documents. The EDI standards addressed the problem caused by paper-based transaction, which is prior to EDI [Emmelhainz 90][Adam 96][Kimberley 91][ANSI 94][Swatman 92][Lavery 93]. EDI allows a business to contact a larger number of trading partners to get more competitive prices on purchases and sales. The VAN (Value Added Network) industry arose to serve those trading partners who could not afford to join a private network. VANs provide connectivity, mail box services, and act as a trusted third party for keeping logs of EDI documents. However, VAN services are still too expensive for small businesses. Hence, recently there has been interest in moving EDI messages over the Internet using one of the many TCP/IP based protocols.

In this paper, we address the needs of small businesses who are not connected to VAN and do not have EDI software, but do have access to the Internet. Big businesses and government have mandated the use of EDI because of the cost saving potential to them. They have deployed traditional EDI system and there are applications deeply coupled with it. However, many small business partners could not afford and maintain EDI software. Currently, small businesses pay VAN charges for EDI messages if they wish to participate in EDI transactions with big businesses or government. The VAN would either translate the EDI messages to ASCII electronic mail, or if the client is not mail enabled, print the message and fax it to the client. In the future, Internet based EDI software [Shih 97] may be available, but its use will also be too cumbersome for small businesses. In addition to acquisition, installation, and maintenance of this software, the small business proprietor will have to establish the trading partner agreement and customize his EDI software to reflect this agreement. Moreover, this software would become *bulky* to be able to support different types of transactions.

We are proposing an architecture that does not require a small business to maintain any EDI specific software. A small business only needs a Java enabled Web browser and Internet connectivity to participate in EDI transactions with big businesses and large government organizations. The World Wide Web is becoming a pervasive media and it is therefore reasonable to assume that a small business has Internet access. In our approach we are exploring two ways of encoding EDI transactions at the big business or the large government organization site. The traditional way of encoding EDI message is in ASCII format, however, we also use XML, an eXtensible Mark-up Language, XML, for encoding EDI messages [XML/EDI]. The tradeoff is that handling of XML based EDI transactions by XML-enabled browsers are relatively simpler. The Internet community is quickly adopting XML and has been already endorsed by W3C. As a result several vendors are working towards making their browser XML-enabled. XML is providing Internet developers with new tools for implementing E-Commerce and EDI solutions [Dowdie 98][Connolly 97]. Our work on XML based EDI system shows that together with XML, EDI will become more flexible, more powerful, less expensive and ultimately ubiquitous.

In another paper, we had reported our work on a Java based EDI system (JEDI) that handles EDI messages encoded in ASCII format [Bunting 98]. In this paper we focus on the XML based architecture. The rest of the paper is organized as follows. In the next section we discuss our approach. In Section 3, we review some details of Java based prototype to handle traditionally encoded EDI transactions. In Section 4 we introduce XML based prototype, and finally in Section 5 we have conclusions and future work.

2. Approach

For the small business, access to EDI documents requires three actions: 1) a transport mechanism to move EDI documents between the client and the server; 2) a compute environment to process that document; and 3) a display interface to present the document on the user screen. Two other implementations were considered prior to choosing the proposed architecture. First, using a Web browser plug-in from a trusted software vendor could provide all three required actions. The fundamental problem with a plug-in is that there are hundreds of different types of EDI messages (called transaction sets in EDI parlance). Furthermore, each message is quite complex, with a large number of optional and conditional segments. A plug-in would need to cover all the messages in their entirety, and hence will become a large and unwieldy piece of software. Also, any update to this software becomes a cumbersome process; a modular software design is more elegant and more maintainable.

The other approach is to use CGI scripts to handle translation and presentation of EDI files on-the-fly to a Web browser displayable format. The main problems with this approach are: (i) it is not scalable as the CGI scripts run on the big business machines, (ii) the interactivity is limited by the bandwidth available over the Internet, and (iii) the communication primitives allowed under HTTP are too restrictive to enable highly interactive applications. Another approach is to use MIME encapsulation for EDI messages as suggested in the Internet community and use the SMTP protocol to transport them [Shih 97]. Once again, the viewer software required to handle the messages once they arrive in the mailbox would be large for the reasons already cited.

In our approach, we use Java applets to process EDI messages. Also, we are working on XML based EDI approach which will be discussed in details in section 4. Both alleviate the EDI specific software requirements on the client side, which is a key benefit for small and medium business.

The overall architecture of a Web-based Java EDI system (JEDI) that is integrated with client and server side databases is illustrated in Figure 1. On the server side we need three major components: EDI Collector, EDI Publisher, and EDI Server Gateway (see Figure 1). The EDI collector receives EDI documents created by the small businesses using Java applets. The EDI server gateway integrates these documents with the existing big business' databases. The EDI publisher extracts EDI files from the big business' database, associates them with appropriate Java applets and makes them available on the Web. Optionally, it would also be desirable for some small businesses to have a method of integrating EDI documents with their databases. This is a motivation for using the EDI standard versus a proprietary format to transmit between server and client. Until recently within the Java applet framework, the client side integration was not possible as the Java applet had restrictions for accessing resources on the client machine. However, now with the introduction of secure applets (JDK1.1) it is possible for a user to allow digitally signed applets to interact with resources on the client machine. To address issues of security and access control support [Marcella 93][Menkus 92] we are currently exploring the use of Java Cryptographic APIs such as the Java interface to the Secure Sockets Layer (SSL) for providing security which conform to EDI Internet standard [Shih 97]. We are also looking at the high end Web servers like IBM Domino that provide sophisticated access control mechanisms. Details of access control and encryption are quickly becoming main stream technologies and can easily be added.

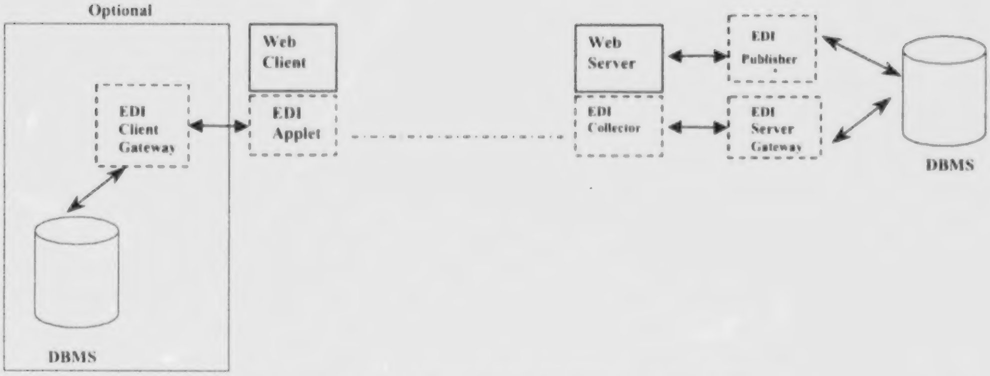
Optional
Web Client
EDI Client Gateway
EDI Applet
DBMS
Web Server
EDI Publisher
EDI Collector
EDI Server Gateway
DBMS

Figure 1. A Java Based EDI Architecture for the Web.

For XML based EDI (see Figure 2), in the server side we still need the EDI collector and EDI Server Gateway. As now the documents transferred between client and server are XML documents but not plain HTML files, we use an XML Author Tool to convert traditional EDI files to XML files. The author tool extracts EDI files from database, and then convert them to XML documents based on the rules stored in Global Repository. In the client side, an XML Parser parses the XML format EDI document first, and it can pass the result to an XML Document Browser for end user to read the document, or to Business Process Logic, which can be viewed as an engine that can integrate the coming XML files directly into other applications, like database, spreadsheet, or workflow system. All the necessary information is contained in the XML document.

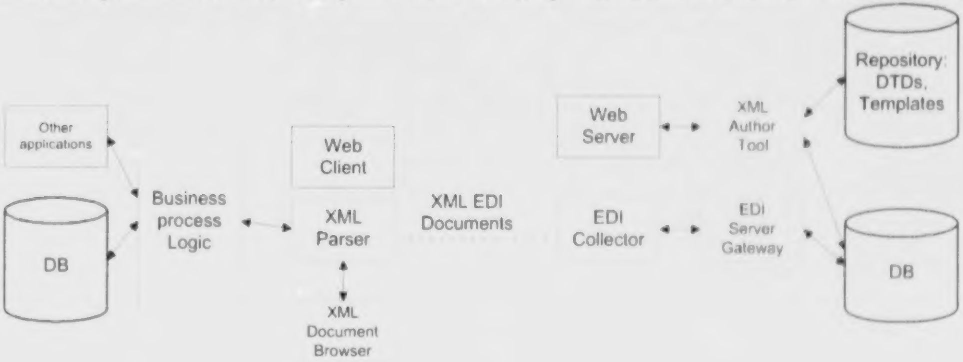
Other applications
DB
Business process Logic
Web Client
XML Parser
XML Document Browser
XML EDI Documents
Web Server
EDI Collector
XML Author Tool
EDI Server Gateway
Repository: DTDs, Templates
DB

Figure2. A Java Based Architecture for XML-Encoded EDI Transactions.

3. Prototype For Handling Ascii-Encoded EDI Transactions (JEDI)

In this section, we briefly review the JEDI system. We have partially implemented the architecture of Figure 1. The components that we have implemented are: EDI applets to support 840, 843, and 856; a simple EDI Collector; and a simple JDBC based EDI client gateway. The following details relate to the applets for 840, 843, and 856. The EDI applet component is an extension of Java Electronic Data Interface (JEDI$_{TM}$ 1.0[1]). The applet runs in a Web browser that supports the Java virtual machine such as the Netscape Navigator or the Microsoft Internet Explorer. The current implementation is developed using the Java Development Kit (JDK) version 1.1 and the Netscape Internet Foundation Classes (IFC) version 1.0.

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[1] JEDI 1.0 is a system that consists of a simple EDI Collector and applets for 840 and 843 and was developed by Bill Bunting and Mohammad Zubair.

The Netscape Internet Foundation Classes provide application framework and user interface components such as buttons, windows, text areas, and other on screen and application framework objects. The Netscape IFC greatly extends the Java Abstract Windowing Toolkit (AWT) library. The Netscape IFC is a feeder and predecessor technology to the Java Foundation Classes (JFC) which is currently under cooperative development between Netscape and Sun Microsystems. The Java Development Kit is planned to supersede the Internet Foundation Classes. Netscape anticipates that transitioning an applet from the IFC to JFC will not be difficult since the libraries will be similar in design.

In a typical scenario, a user (at a small business) clicks on a link pointing to an 840 transaction of his interest. As a result, he downloads the Java applet along with the 840 transaction. The Java applet displays the 840 transaction in a readable form and also helps the user to compose the reply (transaction 843). A user can also click on a link to compose a new 856 transaction. This downloads the Java applet for composing the 856 transaction. The reply to a transaction is transmitted from the applet back to the server through a custom Internet sockets protocol implemented by the *EDICollector*, a Java network daemon application. The network protocol implemented by the *EDICollector* is straightforward and based on the Simple Mail Transfer Protocol (one of the Internet's most successful protocols). For detailed information about the implementation, refer to [Bunting 98].

4. Prototype for Handling XML-Encoded EDI Transactions

We are now working on adding XML capabilities to our current EDI system. The Extensible Markup Language (XML) describes a class of data objects called XML documents, and partially describes the behavior of programs which process these objects. The combination of XML with EDI holds the promise of extending the advantages of Web-based EDI through an open standard to millions of small- and medium-sized enterprises. XML together with EDI provides a standard framework to exchange different types of data - for example, a RFQ, an invoice, an purchase order - so that the information be it in a transaction, exchanged via an Application Program Interface (API), web automation, catalog, a workflow document or message can be searched, decoded, manipulated, and displayed consistently and correctly by first implementing EDI dictionaries and extending our vocabulary via on-line repositories to include our business language, rules and objects. Thus by combining XML and EDI we create a new powerful paradigm different from XML or EDI [XML/EDI].

4.1 XML Introduction

The Extensible Markup Language, abbreviated XML, describes a class of data objects called XML documents and partially describes the behavior of computer programs which process them. XML is an application profile or restricted form of SGML, the Standard Generalized Markup Language. XML was developed by an SGML Editorial Review Board formed under the auspices of the World Wide Web Consortium (W3C) in 1996[16]. Every XML application relies on parser to process XML document. Parsers take the form of a code library that exposes software interfaces to developers using high level languages such as C++ or Java. Using these interfaces, developers can access the structure of an XML document, enumerate its elements and attributes, and play with stuff in the document prolog. A simple example would be an XML parser utility that checks for well-formed or valid documents, and serves as the XML equivalent of HTML syntax checker. Every XML development tool has an XML parser at its core, and the parsers are in turn based on some notion of an object model for an XML document. Now there are a lot of XML parser available in Java, C++, Perl, and other languages.

4.2 Approach

Currently we have defined a sample XML DTD for Transaction 840 (RFQ), and a sample XML file based on the DTD. A user can download the DTD and XML file using a standard browser, and a Java applet will help the user to parse the XML file and translate it to human readable format. The applet uses a Java XML parser (here we use Microsoft's MSXML) to parse the XML documents and gets the XML objects tree.

5. Conclusion and Future Work

In this paper we have proposed a Java based approach to enable small businesses to participate in EDI based transactions. This architecture does not require a small business to maintain any EDI specific software. Small business only needs a Java enabled Web browser and Internet connectivity to participate in EDI transactions with big businesses and large government organizations. The architecture and implemented prototype provide a proof of concept that demonstrate a potentially monetarily cheaper alternative to traditional EDI VAN services that leverage both Internet and EDI technology in place of proprietary solutions. The use of a modular Java object oriented design enhances the maintainability and portability of the implementation.

In future, we plan to work on a XML authoring tool, which enables automatically generating XML format EDI documents based on the information retrieved from back-end database or legacy EDI document. There is also a need to provide traditional EDI mailbox functionality for the small businesses. There are two possible approaches: one is to incorporate at the server side, and the second is to incorporate on the client side. We need to explore the tradeoffs between the two approaches.

6. References

1. Emmelhainz, M (1990). *Electronic Data Interchange: A Total Management Guide.* Van Nostrand Reinhold.
2. Adam, N. & Yesha, Y. (1996). *Electronic Commerce: Current Research Issues and Applications.* Springer.
3. Kimberley, P. (1991). *Electronic Data Interchange.* McGraw-Hill.
4. ANSI (1994), *X12 Standard, Subrelease 003041*, ANSI, Alexandria, VA, February 1994
5. Shih, C. & Drummond, R. (1997). *Requirement for Inter-operable Internet EDI*, IETF Internet Draft.
6. Shih, C. & Drummond, R. (1997). *MIME-based Secure EDI*, IETF Internet Draft.
7. Shih, C. & Drummond, R. (1997). *HTTP Transport for Secure EDI*, IETF Internet Draft.
8. Swatman, P. (1992). *EDI System Integration: A Definition and Literature Survey*, Th Information Society, Vol. 8..
9. Lavery, H. (1993). *EDI Standards - A Tower of Babel*, Global Trade & Transportation, Vol. 113, Issue 10.
10. Marcella, A. & Chan, S. (1993) *EDI Security, Control, and Audit*, Artech House.
11. Menkus, B. (1992) *Understanding EDI Security Issues*, Computers & Security, Vol. 11, No. 6, October, 1992
12. XML/EDI Group, http://www.xmledi.com
13. Dowdie, D. (1998). *XML: The Technology Most Likely to Succeed*, Network World, Volume 15, September, 1998
14. Connolly, D. & Ifkin, A. (1997). *The Evolution of Web Documents: The Ascent of XML*, World Wide Web Journal, volume2, Number 4, 1997
15. Dowdie, D. (1998). *XML is Open, Available, and Important for E-Commerce*, Network World, July, 1998
16. Bosak, J. *XML, Java, and the Future of the Web*, http://sunsite.unc.edu/pub/sun-info/standards/xml/wh/xmlapps.htm
17. Bunting B., Zubair M., & Shi, R. (1998). *A Java Based EDI System Over the Web*, TrEC 98, Hamburg, Germany.

Network-based Professional Development:
A Comparison of Statewide Initiatives

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Abstract: This paper addresses opportunities and issues related to the use of the World Wide Web and high-speed networks as a delivery vehicle for training educators who are geographically dispersed. The benefits and potential pitfalls of using networks as educational platforms are explored from the perspective of various systems specifically being developed to address the needs of practicing professionals in North Carolina and North Dakota. An overview of each of the projects is followed by a discussion of common issues among the projects, including a notion of future prospects for network-based professional development.

Introduction

Professional development in education is in an exciting period of challenge and change as we enter the twenty-first century. The realization of just-in-time distance training for educators is within reach, thanks largely to the ubiquity of the World Wide Web and increasing access to high-speed networks. States such as North Carolina and North Dakota benefit greatly from this type of training, which directly addresses the difficulty of reaching educators who are geographically dispersed in rural areas. This paper discusses initiatives in these states that impact instructors from the elementary level through community college and four-year colleges and universities. As [Fig. 1] illustrates, there are unique aspects as well as commonalties among these diverse programs. This paper will present the projects separately, and then conclude with a discussion of the intersection of these programs and what those common issues might indicate about the future of network-based professional development.

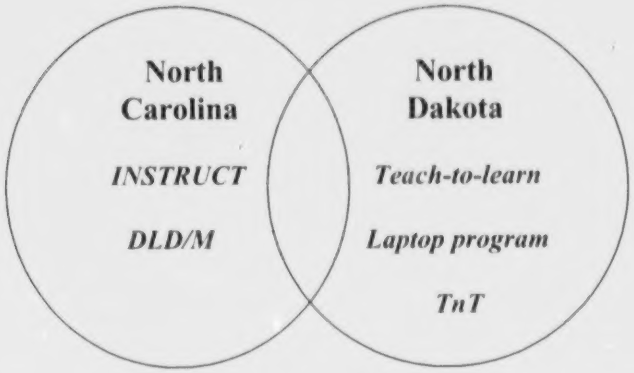

Figure 1: Network-based Professional Development Projects

The INSTRUCT Project

The Department of Mathematics and Statistics at the University of North Carolina at Wilmington has developed a teacher training Web site called INSTRUCT, which stands for *I*mplementing the *N*CTM *S*chool *T*eaching *R*ecommendations *U*sing *C*ollaborative *T*elecommunications. The site is located at http://instruct.cms.uncwil.edu. Since 1996, the site has been used by over 30 teachers from southeastern North Carolina to complete training at a distance that resulted in both licensure renewal credit from the state and technology credit from local school districts.

For the 1999-2000 school year, INSTRUCT is part of a statewide effort called Education Future Now (NOW), coordinated by the North Carolina School of Science and Mathematics (NCSSM). NCSSM has received a $6.5 million Technology Challenge grant from the U.S. Department of Education to address the need for technology training of the North Carolina's K-12 teachers. A major component of NOW will be distance training, which will be carried over both the Web and two-way videoconferencing using seven locations across the state. As a part of NOW, the INSTRUCT program is being offered to up to 35 middle and high school mathematics teachers who have access to the Web. Those not teaching in North Carolina have the opportunity to participate in the program with no guarantee of stipend or licensure renewal credit. The site's resources are available for anyone to use, though to receive renewal credit teachers must be enrolled in the program.

The site contains the following major components:

1. A hypermedia version of the NCTM Standards for Teaching Mathematics contained in the *Professional Standards for Teaching Mathematics* [NCTM 1991], which includes such topics as Worthwhile Mathematical Tasks, Tools for Enhancing Discourse, and Analysis of Teaching and Learning;
2. Online educational resources that cover a wide variety of resource categories, such as Geometry and chaos, Internet project ideas, Lesson planning resources, Statistical data sources, Technology and Web publishing resources, as well as direct links to the state and national agencies;
3. A discussion and meeting area which uses WebBoard™ for posting discussion items or chatting online. The discussion board is open to the public; however, users must register to be added to the access list for chats.

Except for an initial two-way videoconference on navigating the Web and familiarization with Web-based communications tools, all training is conducted over the Web during a single semester. Teachers may opt to participate from either school or home. The INSTRUCT program takes approximately 12 weeks to complete, for a total of 30 online hours and 12 offline hours. During this time, teachers are expected to review hypermedia standards materials, participate in one chat per week, and carry out an ongoing implementation of the standards in their classrooms. Products of the implementation effort include lesson plans and activities reflective of both the NCTM standards and the North Carolina Standard Course of Study, as well as Check for Understanding forms submitted upon completion of each standard. Stipends for participation are made available through various grant awards.

Results from the project to date indicate that not only are teacher practices changing during the semester they are involved with the program, but those changes tend to persist once training is complete. In particular, teachers have noted their willingness to continue trying out ideas presented in the standards material, while at the same time regularly availing themselves of the online resources for mathematics teachers contained on the INSTRUCT site. Each semester, INSTRUCT participants point to the weekly chats they are involved in as the most unique and essential feature of the training, primarily because it keeps them in regular contact with their colleagues in a profession that is often very isolating. Participant comments include: "I enjoyed chatting and sharing ideas with other teachers the most. I don't feel so alone when I know others are experiencing the same things I am" and "I truly enjoyed the on line chats weekly. I think the ability to discuss weekly with other teachers that are working on the ideas that you are trying in your classroom was the most valuable."

In addition, for the last two years a small group of participants have volunteered to continue chatting during spring semester. Each year, one of these chats includes preservice teachers who are preparing to begin their practicum semester. The practicing teachers find the discussion stimulating because of the prospective teacher's enthusiasm, and the preservice teachers have the unique opportunity to ask veteran teachers about their concerns as they look forward to teaching. Nevertheless, the numbers of teachers voluntarily participating in chats once the primary training is complete represents only a fraction of the total number of participants. There is a strong sense that if teachers are not being compensated for their time, either through stipend or licensure renewal credit, it is simply unrealistic for them to make such a time-consuming commitment.

North Dakota Projects

Successful teacher inservice efforts in North Dakota are those that have continued and sustained programs teachers can count on for support when needed. One example is the Teach-to-Learn program. Teachers train teachers in the Teach-to-Learn Model. A Web site contains a database whereby a teacher can post the purpose and time for an evening workshop for others teachers to enroll online. The dependability of this system is illustrated by one second-grade teacher who stated, "Very little time is available for practice in the elementary classroom, that is, to sit down at the computer to practice such simple things as checking for e-mail. So I signed up for the same Teach-to-Learn topic three times until I mastered all the techniques. Learning along with fellow teachers is so important because we all have the same time restraints when tending to students during the school day." Although it was found that immersion with students and teachers is most productive for implementing training in instructional uses of technology, learning to utilize such classroom management technologies requires dependable forums to collaborate with peers.

The statewide laptop program supported by the USWEST initiative for all western states supported this view when data were collected from the 100 participating teachers in North Dakota. The initial workshop training evaluation scores were excellent. Teachers left training knowing how to use the laptop for networking. In the long run it was the bonding during the summer classroom sessions that prompted continued communications through a Listserv connection that provided sustained collaboration among peers. This continued self-enhanced activity was essential for growth and advanced computer utilization.

The same is true regarding the online network for school district instructional technology coordinators and directors. Their continued collaboration through online e-mail discussions and monthly meetings over the statewide Interactive Video Network has enhanced growth and expertise through peer support. These groups collaborated to develop successful regional workshops and a well-attended, weeklong conference held each June called TnT after Teachers and Technology.

The assessments clearly show that the advancements in North Dakota are teacher-based and not necessarily school-based. This means computer technology is not yet an integral part of the practiced curricula. This can best be portrayed by the following qualitative summary: "Our high school is deemed to be one of the most technologically enhanced in our state. It also appears to equal any technologically enriched 10-12 system in the nation, however, it is still possible for students to select a sequence of courses for their entire high school career and not be involved in these technologically-enhanced instructional opportunities we are known to provide learners. This is possible because teachers in every department have not changed despite being trained alongside peers who are models regarding exceptional integration of classroom technology."

Thus, as more and more teachers are learning and re-learning how to utilize computer-based technologies in their classrooms, there is also a need to increase the extent to which teachers are utilizing and extending the use of computers for instructional purposes on an across-the-curriculum basis to reach all learners. The answer for this sparsely populated state with 6,280 K-12 teachers is a $7 million Department of Education Teacher Technology Training grant, which focuses on an intensive effort to continue to prepare teachers for classroom uses of computers during the next four years. This grant resulted from collaborative efforts, which had the capacity to deliver due to previously successful endeavors. This new initiative combines the Center for Innovation in Instruction and the State Board for Vocational Education in a process that selects regional trainers to work with new trainers, along with the teachers who will be receiving this training. Concurrently, state funds, Goals 2000 funds, and School-to-Work grants supplement specialized efforts to support and train select groups of teachers on how to employ specialized computer programs for classroom use.

The North Carolina Community College System DLD/M Project

The Distance Learning Design/Model (DLD/M) Project was funded to address the system-wide distance education needs of the North Carolina Community College System (NCCCS). DLD/M project activities started in October 1998 and ended in May 1999. The primary goal of the DLD/M project was to produce a plan to develop a training program that addresses NCCCS faculty/administrative training goals, and the competencies and infrastructure needed to prepare institutions to deliver distance education. Project outcomes include the development of a planning/training document, a design model, a set of distance learning resources on the Internet, and marketing material(s).

Topics and issues covered within the scope of the DLD/M project include: organizational and administrative design; curriculum design; team-building and personnel considerations; marketing and recruiting plans; student service concerns; and technological considerations of distance education. Since individual community colleges are already engaged in the design, development, and delivery of distance learning courses, we formed an Advisory Board with members representing 12 different community colleges around the state. The advisory board members actively contributed to the development of this project.

For this project, a Training and Needs Assessment Survey instrument was given to faculty, staff, and administrators at eight NCCCS institutions in February 1999. The survey was administered to ten individuals who were selected at each of the eight community college sites by the Advisory Board member affiliated with the community college. When asked if they had ever taken part in distance education training, we found that the responses ranged from 100% to 30%. This shows that distance education training currently varies widely from institution to institution. More significant is that fact that more than

80% of respondents on average would like to take part in distance education training. Perhaps even more surprisingly, respondents stated overwhelmingly that they wanted two or more days of training.

A few respondents indicated that they have already participated in designing, developing, and/or offering telecourses (mostly asynchronous in nature), North Carolina Information Highway courses (synchronous two-way video, time/place bound), and/or Internet-based courses (combination of asynchronous and synchronous). Surprisingly, when asked what they were most interested in working with in the future, most respondents indicated a strong preference for Internet-based courses over telecourses and NCIH courses. This result, taken along with the trend around the country to offer Web-based asynchronous rather than two-way video synchronous courses, indicates that instructor training is most needed in the area of Internet-based course development. For this reason, we emphasized online, Web-based instructional technology competencies/skill sets in our instructor online course development and training plan.

What follows are the training modules that were derived from a list of online teaching competencies/skill sets for NC Community College Instructors as developed from an extensive literature review as well as comments solicited from experts in the field of distance education. These training modules are intended to prepare NC Community College instructors to develop and deliver high quality education at a distance (details of individual training modules have been omitted due to space restrictions; however, a more detailed report can be viewed at http://www.uncwil.edu/people/vetterr/ncccs/).

I. Basic Internet Competencies

A. Unit 1: Introduction to the Internet and Email Use
B. Unit 2: Internet Browsers
C. Unit 3: Research and the Internet
D. Unit 4: Authoring on the Web

II. Using the Internet for Instruction

A. Unit 1: Intro to Teaching Online
B. Unit 2: Administration of Online Courses
C. Unit 3: Course Planning and Organization (Instructional design/pedagogy)
D. Unit 4: Tools for Online Courses

III. Advanced Internet Instruction

A. Unit 1: Advanced Technical Competencies
B. Unit 2: Advanced Multimedia for Internet Instruction

Comprehensive system-wide recommendations for NC community colleges included development of a Distance Education Faculty and Staff Development Center, a competitive grants program for collaborative online course development activities that span across multiple institutions, and a detailed list of competencies/skill sets for two-way interactive video courses (NCIH courses) as well as for telecourses.

Common Issues and Future Prospects

We believe the experiences and lessons learned from the network-based teacher professional development projects described in this paper can be successfully adapted to the needs of other states as well. Already today, the explosive growth of the Web and access to high-speed networks are having a dramatic effect on the way educators view professional development.

We see an increasing role for the hybrid use of synchronous two-way interactive video with asynchronous Internet-based learning systems. This combination provides considerable flexibility (as well as reduced network costs) for the instructor, student, and institution. In addition, as IP-based video systems become more widely available (for example, Microsoft's Netmeeting software system), the need for expensive classrooms with high quality video capabilities will diminish, at least in terms of providing distance educational opportunities to students.

[Shotsberger 1999] notes three distinct advantages of Web-based professional development, which could be extended to include the hybrid model just mentioned:

1. Consistent opportunities for reflection and sharing with colleagues;
2. Shortened cycle for training, implementation and evaluation of new practices;
3. Teacher empowerment through direct access to information.

Teachers are already embracing the World Wide Web in increasing numbers, making the process of training at a distance that much simpler. As the Web continues to mature and evolve in the next few years, enhanced network and software technologies needed for carrying out effective group and collaborative work applications will hopefully encourage greater teacher participation in network-based professional development.

During an intensive, summer-long, faculty-centered Web-based course development effort, [Vetter, Lugo & Ward 1998] discovered that the thought process involved in putting a course online was itself a good model for professional development as it encouraged faculty to re-think the way they teach, interact with other faculty, and develop the support systems needed to retain skills learned. We need to re-think faculty professional development with more emphasis on teaching and learning outcomes, and focus on collaborative development (Web teams, collective reviews and assessments) as a model of learning organization.

In addition, the transition from print-based learning materials to electronic, interactive, nonlinear, network-based learning modules requires further investigation and study [Sologuk, Stammen & Vetter]. Writing professional development Web pages requires a very different style and more dynamic presentation. For example, online materials must be designed with navigational links built in to them and organized in an easy-to-follow fashion. Techniques for creating effective paper-based professional development materials are already well developed. Additional research is required to develop efficient techniques for going from static paper-based models to dynamic electronic-based models.

In the near future, we expect network-based instructional software technologies will mature to the point where many of these issues are satisfactorily addressed. In particular, we expect to see the standardization of instructional systems and knowledge content, improved instructional Web page design, and an increase in software support for collaborative, team-based, teacher training models.

References

[NCTM 1991] National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics*. Reston, VA: NCTM.

[Shotsberger 1999] Shotsberger, P.G. (1999). The INSTRUCT project: Web professional development for mathematics teachers. *Journal of Computers in Mathematics and Science Teaching, 18*(1), 49-60.

[Sologuk, Stammen & Vetter] Sologuk, S., Stammen, R., and Vetter, R. (in press). A collaborative approach for creating curriculum and instructional materials. *Journal of Technology and Teacher Education*.

[Vetter, Lugo & Ward 1998] Vetter, R., Lugo, G., and Ward, C. (1998). Developing fifteen online courses in 140 days. *Proceedings of the Second Annual UNC Workshop on the Use of Technology for Distance Education*, North Carolina State University (September 16-17).

Perspectives on the Implementation of Instructional Technologies into University Environments: Faculty, Administrator, Student

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Abstract: Institutions of higher education have been struggling with various models of implementation of Internet and network technologies. This paper reviews five popular and emerging implementational models and examines three perspectives on these models – specifically, that of a faculty member, an administrator and a student.

The use of Internet and computer technologies in university teaching and learning has provoked institutions of higher education to re-think some basic organizational issues. The scope of the technological undertaking, especially in the context of world wide networking that is facilitated by the Internet, is daunting. Many of the mechanisms underpinning and enabling work in this area must be centrally implemented and supported. And while traditionally, academic units (faculties and departments) at universities have enjoyed and indeed thrived with varying degrees of autonomy, the cost, including the physical, human resource, and transactional of implementing teaching augmented or supported by network-based technologies can be staggering. Thus, new models for university structures are emerging, which are changing traditional political and academic activities, imperatives, motivations and procedures. This paper addresses implementation issues by first setting a context of some accepted models for technology deployment in institutional contexts, and then addressing these models from three vantage points. The emerging models of higher learning and the implications of these transformations transcend societal boundaries – involving the taxpayer, the student or prospective student, the parent, the university employee, faculty member and administrator. Within the boundaries of a classical university, this paper relates the views of a cross-section of direct participants, including a student, a faculty member and an administrator. All are involved in technology at the institutional level and both the faculty member and administrator are involved in systemic, provincial implementations and co-ordination of technological decision making.

Network technologies and the Internet, wedded with the traditional academy, have produced hybrid institutions of learning. In the following pages five models of institutional technological deployment will be described to set a context for the subsequent discussions. There are real world examples of each model, and the list is by no means exhaustive. Many hybrid models exist. As the academy evolves into the new technological environment, there is no doubt that new models will emerge and that increasingly, institutions will feel compelled to adopt an optimal choice for their technological activities to meet their mandated responsibilities.

- **Low Tech:** A number of institutions, especially smaller ones, are finding it difficult to compete with the technological innovations of larger institutions. Since technological infrastructure is expensive, as are initial investments in network infrastructure - switching and server costs are not necessarily directly correlated to student enrollment - the cost of installing and maintaining instructional technology is often not within the means of smaller institutions. There are a number of other compelling reasons that institutions may not choose to invest in instructional technology, including:

$ an institutional plan to occupy a niche market may mandate an investment in faculty instead of technology. A guarantee of small classes and personal attention may serve to situate a small institution very favourably in the post secondary market

$ an institution may decide to upgrade traditional learning support systems - libraries, etc. - rather than transform them through technology

$ an institution may decide to identify and support it's existing technological strengths, rather than work towards a ubiquitous deployment of technology. This type of clustered technology plan mandates investing in existing specialized high output research projects (ie. electron microscopy, particle acceleration, magnetic resonance imaging, radio astronomy, physics simulation, biometrics, etc) rather than student labs, faculty and staff computing facilities, etc.

$ risk avoidance

$ uncertainties about the future of any given technology

$ funding sources may not permit the deployment of expensive pilot programs

This low-tech campus option, the option to not deploy technology, is often overlooked in technology planning.

- **Lab:** The Lab campus reflects a standard model for the distribution of technological resources in an institution. Computers are kept in labs which are monitored by proctors, and are available for general use when not booked for specific classes. The upgrade and maintenance of lab machines has traditionally been an issue affecting the effective deployment of this model. Centralized machines are easy to access, and track. Software and hardware upgrades to desktop computers are however, labour intensive and repetitive, as each machine must be individually maintained. Lab machines are usually replaced every three years. Students in most institutions are more and more reliant on computers for course work, composition, and research and so the demand for the machines rises, as does the demand for software, maintenance and support. Thus institutions working with this model are constantly expanding and upgrading general-purpose computer facilities. The cost of maintaining the facilities rests solely with the institutions. Pedagogically, and socially, the lab is an odd place. The designation and most lab deployments reflect its historical use as a scientific research area. Modern computer labs host a great variety of activities (lectures, synchronous and asynchronous conversations, interactions with curricular software, etc). Additionally, the popularity of e-mail has turned the computer into a means of social communication, so that often, a lab hosts curricular and social interactions simultaneously.

- **Laptop:** The concept of the laptop university is quickly gaining popularity. In this model, the institution provides a network infrastructure that connects all the spaces used by both faculty and students. The student bears the cost of buying the machine - a portable version of the desktop. The multifaceted activity taking place in the lab is thus no longer constricted in terms of space, and can take place in more appropriate or intuitively attractive settings. Researchers can work in the Library with access to the appropriate reference materials, some assignments can be done at home and writing love letters can be a private process, carried out in an appropriately secluded part of campus, or on a grassy hilltop surrounded by the bounty of nature. Laptop universities however, require a fairly elaborate infrastructure to support a successful deployment.

$ Students are faced with a steep learning curve when they first encounter the system, and the mechanics of taking the technology-augmented courses need to be addressed in the introductory curriculum - necessitating an additional curricular development project. This is an even greater issue when instructors choose different courseware packages to deliver their on-line courses.

$ Deployments of laptop universities generally rely on a corresponding, centrally mandated conversion of curriculum into electronic format.

$ A fairly elaborate customer service model for the maintenance of the machines must be implemented to technically support students and professionally develop faculty.

- **Virtual:** Virtual institutions are becoming more and more prevalent. The designation can denote a number of real institutional configurations. Most virtual institutions are Internet-based schools delivering web-based courses, with varying degrees of opportunity for face to face traditional classroom-based instruction. Some exist only on the Internet, relying principally on lifelong learners as a student base and work at expanding the traditional distance education markets. Some, like Western Governor's University, use seconded faculty and have no permanent faculty members. Virtual institutions are geared towards providing an educational service to clients who, for geographical, lifestyle, work, or other reasons, do not want to or can not attend a traditional campus. This is the traditional distance learning market, but the virtual institution is offering a more refined, quicker, more satisfying, more academically and socially engaging experience than print-based distance courses have achieved. Virtual campuses generally strive to gauge the needs of traditional students and deliver comparable services to remote students.
- **Networked System:** A new model for politically mandated integrated post-secondary systems is being examined in a number of geographical areas, among them the province of Alberta, in Canada. This model demands that curricular material and credit be fluid and systemic. It depends on the notion that students need not be tied to an institution and that they would be better served by a system consisting of discrete, identifiable parts. It also depends on an integrated and co-ordinated deployment of technological tools to facilitate an individualized learning system. This model requires a great deal of political decision making, and negotiation, but affords students the opportunity to build degrees, diplomas and certificates from a wide range of possible providers. Students, as consumers of the system, are empowered to choose the mode and content of the courses they take.

While each of these models can be compelling, simple and perhaps even obvious, and each provides a solution to an identified problem, each also is rife with implications that are pervasive and stand to transform academic institutions as we know them. Because the impetus driving the incorporation of network technologies into the teaching and functioning of universities around the world is political and economic as well as academic, these models of institutional uses of technologies or institutional refashioning are compromises that seem to please few involved in the transformative processes. The function of planning has changed in the technological environment along with the relative importance of various institutional plans. More importantly, the need to integrate various plans, always a goal of institutions, has become a necessity without which, universities can founder and fail. Additionally, the emergence of technologies as mediating agents in curricular, social, economic and support transactions has encouraged a degree of interdisciplinarity and integration, an imperative for institutions, departments and individuals to trespass over boundaries that are seminal to the traditional academic institution's operation.

Perspectives

The perspectives of three individuals from stakeholder groups strongly affected by technological refashionings in educational institutions are represented in this section of the paper: a faculty member, an administrator, and a student. All three have been involved with network-based technologies and have seen their environments adapt in response to them. Each will comment on the technology models described and each will provide their unique perspective on the process of incorporation as well as the day to day use of these technologies in the context of an academic institution. As well, each will address concerns and hopes for the technologies and speculate on the future of their roles within the greater academic and institutional environments.

Faculty Member

As a faculty member at the University of Lethbridge, I lead technology planning and implementation and help other faculty to integrate appropriate technologies into their curricula. I also research and assess new instructional technologies. Additionally, I sit on the Alberta provincial Advisory Committee on Educational Technology, and participate in the affiliated Standards Task Group.

My background and current position lead me to believe that centralized, cross-disciplinary and long-term planning for technology implementation is vital to the success of any institution considering a technological renaissance. Each of the models included in the panel summary has its merits. Some are economically efficient, some are elegant and simple, and some are flexible. My enthusiasm for them is tempered by my concern about traditional academic values and the traditional academic environment that has proven so conducive to the creative pursuit of new knowledge.

As a faculty member and a stakeholder in the higher education system, as well as a taxpayer and parent, I am concerned that academic autonomy, so fundamental to the academic culture, is being compromised in the process of implementing technology. The new forces molding the academy include business concerns and political pressure – both forces traditionally involved with administrating and funding higher education, but not with the development of curricula. In some of the models listed in the introductory paper, it is apparent that curricular change is being mandated systemically. This flies in the face of academic freedom, which is fundamental to the institution of the university. Although I recognize the need to rework the methods of implementing technologies to take advantage of economies of scale optimizing both physical and intellectual resources, I feel that caution ought to be exerted and much thought devoted to the larger implications of these changes on scholarship, creativity, critical inquiry, and intellectual development.

The Low Tech option, for instance, is naturally appealing, especially to faculty members at small institutions. This model seems to leave intact the fundamental structure of the university, preserving it in time so to speak. However, what of faculty who wish to pursue technologically augmented teaching? What of students who need to be comfortable with technology in order to be job ready? Again, institutional motivation comes into play. Are we serving the taxpayers who foot the bill? Are we serving students, who also pay? Are we serving the greater good by developing new knowledge? Are we accountable to the politicians who dole out the funds? Are we responsible to corporate bodies who donate research funds? University policy, in fact, treads a fine line of compromise winding between these and other forces.

Fundamentally, these teleological issues need to be resolved before the issue of technology even begins to be addressed. Once an institution has established its purpose, and fundamental motivation, the rest of the issues are academic. For instance, if the focus is on students, as clients of the university, their experiences and education, then obviously small classes are important – students learn better with more. As well, technology is important, since students need to have access to it in order to do their work and qualify for jobs. As custodians of their money and futures, we should create an environment optimal for students.

However, the situation is never simple. Institutions of higher learning function in a multifaceted context. As faculty members we are rewarded generally, for our work in research first, teaching next, and service to the university and community last. This necessitates working in an environment that streamlines the production of curricular materials. The economies of scale can work for us here, ensuring that the technological context for our work is centrally implemented and supported, that our research and curricular assistants are working in a single technological context, minimizing the need for technical re-training.

Another issue that must be reflected upon before embarking on any scheme to refashion the academy is the relationship between the content and delivery of curricular materials. Two of the models initially discussed, the Laptop and Virtual, mention the redesign of curriculum. In the spirit of acknowledging the relationship of the medium and the message, institutions must accept that redesigning curriculum for delivery in a technologically augmented or mediated environment means tampering with course content. Instructors must be free to choose the best mode of delivery for a content area, rather than try to fit a subject into a context that may not be conducive to the delivery of that particular subject. Even more disturbing is the assumption that existing course materials can be handed over to an outsourcing agency, which can "transform" them into a format suitable for electronic delivery.

Granted, the realities of the modern academic environment dictate that long term technological planning be visionary and binding. However, it also has to be integrative and thorough. It needs to take into account the mission, goals and underlying purpose of the institution. It has to acknowledge the complete cost of the work – including the increased workload on faculty, who ultimately, are the front line workers in the enterprise. Any externally mandated curricular transformation must be accompanied with tangible faculty rewards and a complete technical and intellectual support system. Furthermore, it must include professional development for faculty who need to work with new and different paradigms for instructional design.

Ultimately, it is hard to conceive of an academic future where technology plans are not centrally developed. Economic realities are compelling institutions to adopt centralized and comprehensive planning policies that include curricular changes. It is vitally important, however, to acknowledge in these planning processes the academic structure and atmosphere that has facilitated the scholarship, critical and creative, to date. I predict that future institutions will attract faculty not just through strongly developed research opportunities, but also through well developed and implemented planning, especially technological planning which will set a context and environment for their teaching and professional growth.

Administrator

I work in a senior administrative position at the University of Lethbridge and focus on the areas of project management and institutional planning. My responsibilities include maintaining awareness of both internal directions and external issues, trends, and policy directions for the provincial post-secondary system. I serve on various institutional and provincial technology integration planning committees, and provide liaison between government policy makers and university administrators and faculty members.

While the range of learning and educational technology options increases, so too does the potential for misunderstandings and accusations of unrealistic expectations among the various stakeholders. From the perspective of a seasoned post-secondary institution and government administrator, I will present some of the economic, political, and administrative considerations that must inevitably, and hopefully consciously, factor into the selection any of the identified technological options.

To set a context for my position, I will first identify some of the relevant characteristics of the Alberta post-secondary system and, more specifically those of the University of Lethbridge. I will not, however, identify a preferred option. I do not have a recommendation for the provincial system, nor for that matter for the U of L. To do so would also presume some planning decisions that are outside my area of expertise and purview. Inarguably, all post-secondary institutions are in the business of providing educational and/or skills training opportunities that best address student needs, meet their mandated responsibilities and the demands of the economy. I see the administrator's role as helping to facilitate, plan for, and implement the option identified as being the most pedagogically and conceptually sound by the educators who have conducted the research necessary to determine which are the most appropriate learning environments.

Twenty-six Alberta institutions, ranging from vocational/upgrading colleges to four universities, compete for dwindling tax dollars that are earmarked for publicly funded post-secondary education. The U of L is a relatively small institution (approximately 5400 students) that is mandated to deliver liberal education and professional preparation through its five faculties and schools (Arts and Science, Health Sciences, Education, Management, and Fine Arts).

In 1994 the provincial government set out a new direction for its publicly funded post-secondary institutions. It identified numerous initiatives that focused on increasing responsiveness, accessibility, accountability, and affordability (both for taxpayers and students). What was very apparent, and new to the system, was the increased emphasis on:

- reducing system-wide duplication of programs and services;
- rewarding institutions for developing collaborative undertakings;
- increasing the number of student seats in high demand program areas;
- increasing rewards for learner-centred practices including, for example, seamless student services (electronic application service);
- providing only for rationalized infrastructure expenditures;
- standardizing reporting processes; and,
- promoting innovative practices e.g. integration of technology and recognizing more business oriented credentials ie. those with either a significant co-op or practicum component such as post-diploma and applied degrees.

Another of the major changes was the move from formula-based (percentage based strictly on student enrolment numbers) to envelope funding which required that institutions adopt a more entrepreneurial orientation and compete for various funding envelopes. At the same time, institutions were struck with a 21% (over 3 years) cut to their operational budgets. More market responsive and business driven decision-making was obviously required. Cost effectiveness became the focus of post-secondary administration. Regular business, technology integration, research, and accessibility plans were required from institutions in order to regain maximum funding. Within an increasingly competitive environment, the requirement for enhanced inter-institutional collaboration became, and remains, an anomaly. Student tuition fees were also capped at 30% of operating costs.

Faculty and student expectations, without the benefit (or disadvantage, depending on perspective) of being in direct contact with policy makers and funding agents, were slower to respond to the changing requirements and assumed that business would continue as usual. Personal objectives and goals, due to economic necessity, became subordinate to achieving institutionally mandated responsibilities including what were presumed to be technological efficiencies in educational delivery. Faculty members, in the absence of having had the opportunity to develop their knowledge and expertise or even conduct research into the pedagogical implications, felt pressured to adopt technological alternatives either on a broad or limited scale. A kind of 'shoot the messenger' mentality seemed to emerge as administrators were seen as being responsible, if not wholly, in part at least, for not being able to re-deploy resources in a way that would not impact the teaching/learning environment.

Due to external politically- and economically-imposed pressures, institutions sought the means by which to enhance accountability results in order to secure higher funding allocations. In this context, alternative means of educational delivery via technological assistance were examined. Universities started to pay greater attention to market demand - students, their advisors, and parents were increasingly seen to be *customers* of institutional services. Streamlining and simplifying administrative procedures, as well as student and support service delivery, generally expedited through some technological assistance for such important processes as financial, counselling, and registration, required that internal processes be more widely understood and communicated. Responsiveness to market demand and competitive pressures, despite the crassness of its ring to educators, became necessary. It would probably not be an overstatement, for some institutions at least, to say that institutional preservation continues to depend on making good, fiscally sound choices - with little room for error. Administrators, by virtue of their 'watchdog' status, have the appearance of presuming to interfere with academic delivery. Preferably, theirs could be viewed as more of a mediational role - communicating and interpreting external constraints while appreciating and respecting internal educational preferences and directions.

A few of the specific considerations that administrators are obliged to address that directly relate to the various technological options include:

- physical space change requirements - more, less, or different use
- collaborative arrangement coordination
- one-time and setup vs. lifetime costing
- approval processes
- policy implications

- project management
- process planning
- timeline coordination
- publication and communications requirements
- effect on total program array and/or change in student numbers
- professional development and/or training considerations
- maintenance, upgrading, and replacement costs
- intellectual and/or product ownership implications
- impact on student tuition and/or other transferred costs
- staff and faculty number and location implications
- funders eligibility criteria, guidelines for disbursement, and subsequent reporting requirements
- revenue generation opportunities
- coordination of response time with market demand forecast
- consistency with strategic direction
- risk management

These represent only a few of the considerations that are possibly less evident to faculty members as they select from the presented, or other, technological options. Some are undoubtedly unique to the Alberta post-secondary system; others are likely common regardless of jurisdiction or type of institution. They are presented to provoke discussion and indicate the range of administrative considerations that are inevitably important to complement educational delivery change decisions. Consultative planning, which implies developing an appreciation of all stakeholder perspectives, is necessary prior to decision-making to minimize unpleasant surprises and maximize positive outcomes.

Student

In September 1995 I became a University-transfer student of Concordia University College and transferred in 1997 to complete my BA (Honours, Psychology) in May 1999 from the University of Alberta in Edmonton. I have not taken any distance courses, but I have been exposed to an array of classroom technologies. I have made extensive use of computers, both in the student labs at University and at home. When I graduate, I expect that computers will be part of whatever career path I decide to pursue and that I will constantly have to learn new applications and deal with different interactions involving computers.

My use of computer technology while attending College and University was mostly directed at my studies. I used word processors, databases, spreadsheets, statistics programs, and presentation software regularly. I also used a variety of tools to access the Internet for research, library and other. As well, e-mail was, and continues to be, a fairly important part of my life – both for academic and career research work as well as for social purposes.

I can see that there is real and undeniable value to technology - especially the kind that lessens the on-campus residency requirements - perhaps more for other students than for myself. For instance, disabled students, who are unable go to campus for regular face to face instruction, mature students returning to school, at-home parents, or those with full time jobs have access to a world of education that circumstances had kept them from before. As well, computer communication allows people to easily keep in touch with people anywhere in the world. This is important not only to students looking for mentors or information in remote places, but also to people whose interests are not shared with those in their local communities. The typical student however, like me, values the campus experience mostly for its social opportunities. The university is a setting where we meet peers, socialize with like-minded people, argue and persuade, learn from each other and enjoy each other's company. This is not something I would be willing to give up, even for very effective communications technology. Although e-mail is a social tool for me, I would not want it to be the only one.

The five models described in the introductory paper are all ones that I have heard mentioned by students and professors alike in discussions of possible futures for the University and possible ways of conducting courses. My comments are based on my presumptions about the benefits and deficits of each option. I have attempted to briefly point out the most significant positive and negative aspects from a student's point of view.

University Model	Benefits	Deficits
Low Tech	◆ tuition should be cheaper	◆ restricts students' future opportunities ◆ employers may pass over this type of experience in a high tech society
Lab	◆ cheaper than having to buy your own computer	◆ chaotic environment, in many labs there is no privacy for e-mail or quiet work ◆ students who own computers subsidize those that don't and rely on the labs

Laptop	◆ students can work, study, and do their research in a variety of settings, for instance, at home or work	◆ expensive – tuition is already too high, and students are graduating with too much debt
Virtual University	◆ limits some costs and provides convenience	◆ limits some day to day social interaction
Networked System	◆ convenient for students who want to mix on-line with regular courses and who don't want to leave their homes to attend school	◆ maintaining the value of the credential ◆ limits options for individual course selection i.e. reducing duplication also reduces choices

As you can see, no single model emerged from this exercise as a clear winner. I think that I can unequivocally say that I would not want to get my degree from either a Low-tech or Virtual University. I need and want technology in my education, but I do not want it to be the focus of what I do. I am first and foremost interested in psychology, in its course content and the related research. I want psychology to be the focus of my career and for technology to enable me to be the best I can be in that field. I worry that the emphasis on technology in delivering university education will divert it from what's important to students, from what keeps students like me at university. Technology will not be the focus of my life, but I do appreciate and enjoy its utility in helping me learn, research, share information, keep in touch with friends, be entertained, write, and I look forward to whatever else it will do in the future.

Technology has the potential to make student life much less complicated. It could eliminate lineups for student services, and streamline the bureaucratic entanglements that students have to clamber through. It could help students who are transferring from one school to another to know exactly what to expect in terms of credits, services and requirements at the new institution. It could give students more choices about their own education. I hope that this is what technology ends up doing in universities. The possibility exists that it could also just add another layer of cost and intricacy to the whole experience, which is already expensive and complicated. It could, potentially, free up time to 'learn'.

Future Considerations

Clearly, technology is very much a matter of concern and contemplation for various stakeholders in university education. Each considers the academic and professional impacts, or potential impacts of technology. The selection, deployment, and implementation of technology in university curricula have far reaching consequences, and it seems that these consequences will affect us whether or not we choose to participate in the processes. Pressure from students, governments and industry will eventually ensure the integration of network technologies into portions of all university curricula.

The three individual perspectives provide a sample of the some of the more general concerns that face university faculty members, administrators, and students. Probably the most important point prior to making any far-reaching, resource intensive decisions that will have significant professional and academic impacts is to have a clear understanding of the expected educational outcomes. The stakeholder perspectives need to be confirmed and elaborated or refuted by a representative cross-section. Perhaps equally as important is that this feedback be complemented with perspectives from those not as directly involved in technology integration (parents, business community, other university staff, college personnel, government employees, potential students, etc.) to develop a more comprehensive picture. Presumably then, confidence will be enhanced in the suitability of the chosen option, resources to support the change will be more readily forthcoming, and there will be greater assurance that educational benefit will be realized.

Using Standards to Realise the Vision of a World-wide University

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Abstract: This paper presents a vision of a world-wide university and describes some features/scenarios that we expect to find in such a future. It then points out that the current lack of technical standards in educational technology presents an insurmountable barrier to the realisation of this vision. On a more hopeful note, the paper introduces several significant initiatives that are attempting to address this issue, and enumerates some of the benefits and costs to the key stakeholders.

1. Introduction - the Vision

Many agents in the academic, commercial and military sectors share a vision, referred to variously as "The Global/Virtual University/Campus". Our preferred term is the world-wide university (WWU). This vision is of a world-wide education marketplace in which vendors can sell their educational offerings to learners, using Internet technology as the medium for marketing, trading and delivery. In this market place, vendors may range in size from small startup companies to large consortia of institutions. They may spring from traditional universities, from industry-based training agencies, or they may be completely new enterprises. The units of learning may be as small as a single "lesson" on a very specific topic, perhaps offered by a lone academic, either direct to learners, or indirectly via a larger commercial entity. Alternatively, they may be as large as a full honours degree, perhaps offered by one of the new virtual universities. Similarly, learners may register and pay for units of vastly differing sizes, and on successful completion of those units be awarded internationally (and electronically) recognised credits of appropriate value. Learners may enrol as individuals or as members of larger groups, perhaps organised by intermediary organisations who can offer value-added services.

This vision has sprung from more than one source. On the one hand, there are idealistic academics (in the positive sense of the term) who have seen the potential of technology for transferring power from teachers and institutions, to learners. In a world-wide university learners will no longer have to put up with learning programmes designed for the administrative convenience of the institutions which offer them. Instead they will be able to pick and choose modules to create learning programmes tailored more closely to their needs.

On the other hand however, the vision may be seen as a response to a perceived crisis. A crisis in which increasingly complex societies, facing an accelerating rate of cultural and technological change, require ever more sophisticated workforces with constantly updated knowledge and skills. Addressing this problem requires the adoption of a lifelong learning culture, and educational systems, which can deliver lifelong learning on a massive scale. Not surprisingly perhaps, the technology which is in part responsible for the problem, is turned to in search of a solution, as our governments hope that the idealists' attempts at realising their visions might provide the pillars to support a lifelong learning culture.

Certainly, an impressive array of educational technologies has been developed or refined over the last decade, including:

- Computer Aided Learning (CAL) software (time and location independent learning)
- Videoconferencing (location independent learning, useful where visual cues are crucial to the interaction)
- Computer based simulations (e.g. of hazardous, complex or expensive laboratory experiments)
- Computer based assessment (time and location independent, and efficient from the assessor's viewpoint)
- Collaborative learning environments, enabling synchronous and asynchronous collaboration between learner and learner, learner and tutor, or tutor and tutor, even when the participants are geographically dispersed.

- The use of the Internet, especially the World Wide Web (WWW) as a delivery medium for all of the above.

Wherever the vision may have sprung from, in many parts of the world we can see initiatives using communication and information technologies in its pursuit. In the UK for example there are the Computers in Teaching Initiative (CTI), the Teaching and Learning Technology Programme (TLTP) and the National Grid for Learning (DfEE, 1998). In the European Union there is the Fifth Framework Programme, while in the US there is the Advanced Distributed Learning project (ADL).

2. Standards

Given the impressive developments of recent years, and the growing list of initiatives such as those listed above, it is tempting to believe that the above vision is close to becoming a reality. We do, indeed, believe that this vision will become a reality, but there are serious inhibitors, which still need to be overcome. One major inhibitor is a lack of technical standards for managing online educational content and courses. Look inside the educational technology developed in any of the projects cited above and you will find similar functionality being implemented in different - and incompatible - ways, making it difficult to use resources from different projects in an integrated, coherent manner.

A lack of standards for managing online educational resources means that:
- teachers (and learners) cannot easily locate suitable resources, even though the resources they need are almost certainly "out there somewhere".
- teachers (and learners) cannot easily create bespoke educational offerings using resources from diverse sources (even if they can find them)
- information from one resource cannot easily be used by another (e.g., results from an online assessment component cannot easily be used by a presentation component to determine a learner's level of knowledge, and therefore the most appropriate path to take through the presentation).

A lack of standards for managing online courses means that:
- institutions cannot easily engage in sharing of administrative records necessary to form virtual partnerships
- learners cannot easily transfer credits among institutions and between institutions and employers.

The good news is that the world is finally waking up to these issues, and the need for standards to address them. There are currently two relatively mature projects, both US-based, attempting to define standards for educational technology. These are IMS and the IEEE Learning Technologies Standards Committee (LTSC). In addition, the European Union has recently issued a standardisation mandate (see section 2.2).

2.1 IMS

IMS is a global coalition of educational, commercial and government organizations that is driving innovation in the distributed learning marketplace. Its goal is widespread implementation of a set of technical specifications for software that will make it easier to publish distributed learning content and for people to use the content in multiple ways and on multiple learning systems. IMS is part of the EDUCAUSE National Learning Infrastructure Initiative, and makes all of its technical specifications and other released deliverables available at no cost. It does not endorse member products and, at this time, is not certifying product conformance with the specifications. IMS has centres in the United Kingdom, United States, Singapore, and Australia, as well as members in a number of other countries.

2.1.1 The UK IMS Centre

In early '98, the UK's higher education Joint Information Systems Committee (JISC) decided to become an IMS investment member. Immediately prior to this, there had been some quite large scale funding of content development in the higher education community, most notably through the CTI and TLTP programmes. The point had been reached where it was becoming more widely understood that:

- content needed to be able to operate cross platform rather than be tied to a specific delivery or learning management platform, for which Web standards were emerging as the best candidate for building on
- large volumes of online content would need separate management tools to find, store and organise them into courses prior to delivery
- learning management systems needed to interoperate with administrative enrolment and student record systems to provide the start and end points of units of learning, and this should be in a non-proprietary way
- learning management systems needed to support interactions between teachers and learners and between learner peer groups before and during the learning process, as well as to provide facilities to tailor learning more closely to the needs of learners

Recognising the need for standards to enable the above, the JISC sought bids from UK higher education institutions to run a Centre whose task it would be to represent the viewpoint and needs of UK higher education to IMS, as it developed its specifications, and to inform UK higher education institutions of these specifications and their significance, and provide early access to them as they developed. A joint bid between the University of Wales Bangor and the Open University won the contract and the UK IMS Centre was set up in May '98.

The UK IMS Centre was the first such non-US based centre to be set up. IMS in the US had already recognised that to be effective, the specifications they put forward would need to be acceptable on a world-wide basis. It is very difficult when working within a particular culture, to recognise what is unique and specific to that culture and what is more universally shared. A case in point was that in the early versions of the IMS specifications, it was proposed that all distance learning would be carried in real time over the Web, connected to a Learning Management System mediated through a Web server. The assumption behind this, true in the US but not (yet) elsewhere in the world, is that everyone has free local phone calls and therefore pays no charges to access the Web via their local internet service provider. Elsewhere, where learners are trading 'earning time' for 'learning time', this would cause an immediate barrier to the use of ICT for distance learning. Another case was that by the end of '98, the candidate for v1.0 specifications only supported individualised delivery of learning with no support for learning in classes or for group learning. The UK IMS Centre worked hard to get support for these included.

In addition to a number of awareness raising exercises, the UK IMS Centre has begun workshops on the emerging IMS specifications, and is now planning to work with small groups interested in trialling the draft specifications through interoperable implementations, building up experience of their use, feeding back any findings in to the IMS process and providing prototype tools which can be used to start using the specifications on the field.

2.1.2 The Singapore and Australia IMS Centres

The Australasia IMS Centre is funded by the Department of Education, Training and Youth Affairs, and operated by the University of New England. It serves the entire higher education community in the region, and has been active in promoting industry relationships, workshops and other activities. The IMS Asia Center is operated by the Kent Ridge Digital Labs, on behalf of the National Computer board, and serves the entire Asian region, including such countries as China, Japan, Malaysia, Thailand, Korea and others.

2.1.3 The IMS Developers Network

In addition to the aforementioned Centres, IMS operates a world-wide Developers Network with around 200 member organisations. New chapters of this organisation are being set up in several European countries, including the UK, Finland, Greece, Italy and Ireland.

2.2 The European Standardisation Mandate and Memorandum of Understanding

In November 1998 the European Union, with input from IMS and other groups, decided to take action in this area and issued a standardisation mandate in the domain of "Learning and Training Technologies & Educational

Multimedia Software". It also issued a Memorandum of Understanding - a declaration of intent, with over 300 signatories - to work towards specifications of requirements for standards for multimedia learning technologies. This initiative has now been named PROMETEUS. Associated with this activity is a CEN/ISSS Learning Technologies Workshop that constitutes the standards effort within the EU.

2.3 The Learning Technologies Standards Committee

The IEEE working group P1484 (now renamed the Learning Technologies Standards Committee - LTSC) is another prominent US initiative developing standards for various aspects of learning technologies. As an IEEE initiative the LTSC can be seen as setting "de jure" standards. The process of defining these standards is carried out by a number of working groups, each of which addresses a different aspect of the problem. For example, a Learning Objects Metadata working group is defining standard ways of describing learning resources (this working group recently released Version 3.0 of the IEEE LTSC LOM specification document for public comment prior to balloting).

With three prominent initiatives all addressing standards for learning technologies, one might be forgiven for recalling the old computing industry adage "of course we like standards - that's why we have so many of them!". However, all of these standards initiatives are actually talking to each other, so we can hope that the situation will not get out of control. IMS is in the process of developing an "official liaison" with the CEN/ISSS activity, and has worked extremely closely within the IEEE group, so in actuality there is less divergence than the presence of several groups might suggest. It should also be noted that IMS, CEN/ISSS and the LTSC are all "open" initiatives that welcome participation from whoever is willing and able to contribute. A notable example of this collaboration is the significant contribution made by the European Union project ARIADNE to the LTSC metadata specifications, which also built on the Dublin Core metadata specifications [Dublin Core Metadata Initiative]. It therefore seems probable that the "de jure" standards eventually ratified by the LTSC will incorporate specifications from IMS and CEN/ISSS, as well as other sources.

3. The Role of Standards

It needs to be clear however, what role technical standards are intended to play. Essentially their function is to enable communication between all the various pieces of an integrated learning technology solution. A key function in the new scenario is that of learning management. This provides support for the learning process as it takes place, and is distinct from, for example, student enrolment, student fee and student record systems. However it critically needs to communicate with these functions, so standards are needed to enable the exchange of information about class enrolment, access permissions, and outcomes. A learning management system also needs to provide learners with access to appropriate online resources. These range from simple web pages, through software packages to complex online systems, such as databases and simulations. It therefore needs to communicate with metadata systems which describe a whole variety of learning resources, with a content server, with test systems and with student learning profile systems. Again both the format of the data and the method of communicating it needs to be defined. There are several other areas that also need to be defined to enable groups of learners to collaborate, and for information about groups to be exchanged. Running through all of these are issues of security and eCommerce for which efforts are also underway.

Stepping back from this, and remembering that the standards efforts are aimed at effecting communication between systems, it becomes clear that such standards do not specify what should be happening inside these sub-systems or even the kinds of system that emerge from their use. It is especially important to recognise that the standards are not intended to specify or in any way constrain the pedagogical approach taken by the author of a learning resource, nor the user interface adopted. To illustrate this, two contrasting systems are outlined, both of which could make use of the same specifications.

The first focuses on the delivery of content and automation of testing as the primary aim. The role of teachers and subject experts here becomes one of content and test creation. They work as part of a multi-skilled production team including psychologists, UI designers, graphic artists, animators, programmers and AI experts. Learners pass through online systems which elicit their learning goals, test their current knowledge and skills, and provide them with appropriate learning programmes which they then work through, taking tests at the end or along the way which either cause remedial alternatives to be offered, or add to an accumulating score on the way to an electronic certificate.

In contrast to the first system, where communication between teacher and learner is programmed out of the learning loop, the second system seeks to enhance this communication and add in peer communication between learners. There are still resources available or to be searched for as the need arises, but in this system learners are enabled to determine and undertake collaborative projects. The emphasis in this system is to minimise time-consuming routine tasks, allowing teachers to focus on the unique value they add which is to understand the complexities of the subject and of the learners, helping them develop new conceptual structures and overcome mental blockages, often through identifying misunderstandings, to convey insights and enthusiasm.

4. Costs and Benefits of Adopting Standards

From these examples it becomes clear that there are no simple cost/benefits to be derived from the adoption of learning technology standards. In each case the impact and demands on the various stakeholders is different, and we need to bear in mind that these are just two of a range of possible ways in which learning technology and learning technology standards can be harnessed. It depends on the nature of what is being taught - the first of the above examples being better for factual learning within an existing conceptual framework and for developing skills; the second for helping learners integrate new understanding and possibilities, developing their abilities to work in teams, to analyse and devise ways of dealing with new problems, etc. It also depends much more on what vendors choose to support within the learning management systems they offer, and how easy or difficult they make it to perform the tasks involved in various different approaches to learning.

Nevertheless, the success of any standards depends upon the willingness of the relevant stakeholders to adopt them. This in turn requires that these stakeholders can see an attractive costs/benefits ratio; i.e., that they can see significant benefits in adopting the standards and that the costs of doing so will not be too onerous. It is therefore worthwhile to attempt to identify these costs and benefits even though, as we have seen, it is not always a straightforward task. The set of stakeholders can be broadly characterised as learners, teachers, resource developers, technology vendors and academic institutions. This section attempts to outline the costs and benefits of adopting technical standards for educational technologies, for each of these stakeholders.

3.1 Learners and Teachers

The benefits to learners and teachers have already been enumerated in earlier sections of this paper and will not be repeated here. As for costs, it is difficult to see any real costs at all. As in other areas, a standards-enabled educational market place is a win-win situation for the consumers.

3.2 Resource Developers

It takes an enormous effort and a great deal of human resources to produce a high quality learning resource, whether it is a multimedia presentation or a collaboration-enabling device. Large, monolithic resources have not, in general, proved successful, largely because it is difficult to produce a large resource in which all parts fit well with the teaching and learning styles of many different teachers and learners. Modular, interoperable learning resources can greatly alleviate this problem by allowing teachers and learners to "pick and mix" their resources from diverse sources. This greatly enlarges the potential market for resource developers, whose standards-enabled, interoperable resources can be used in a much wider range of scenarios, and on a much broader range of platforms, than is currently the case. With regard to costs, there are some implications for resource developers. One example is the requirement to understand the standard metadata schemas and to make their metadata conform to these schemas. The more technical issues (e.g., of courseware interoperability) should be taken care of by the tools used to develop the resources, and so are the concern of the technology vendors.

3.3 Technology Vendors

Just as resource developers benefit from a market that is enlarged by the existence of open standards, so do technology vendors. Developers of educational resources currently have to make decisions about which tools to use, based on which tools target their chosen platform, and what other tools and systems can utilise the outputs from the tool under review. This means that technology vendors are currently competing in small fragmented markets. In a standards-enabled market, these fragments coalesce into a larger more unified market, as technology vendors ensure that their tools can be used alongside all the other standards-compliant tools. There are very real costs for technology vendors in adopting standards however, as they must re-engineer their products. Those vendors who join in early with the standards building initiatives will have a definite edge when it comes to selling their products in the new standards-enabled market.

3.4 Academic Institutions

The benefits to academic institutions have also been described in earlier sections of this paper and will not be repeated here. Of course, implementing the necessary gateways to enable the exchange of standardised student related information will require investment by the institutions, but those managers who see this in negative terms will have to consider the cost (of isolation from the global education marketplace) of not making this investment.

5. Conclusion

The potential of educational technology for transforming the educational market place is immense. Learners can be empowered, access can be extended, teachers can be even more creative and can "reach" many more students than before. But the world-wide university is not yet a reality! The vision will only be realised when an effective set of technical standards have been adopted which enables educational resources to be located, obtained and integrated, and student information be transferred between institutions, real or virtual. As set out early on by IMS, learning technology standards should not dictate what is taught or how, but rather should be generic and inclusive enough to support a wide range of pedagogies. This is a very useful touchstone for judging learning technology standards, and is crucially important in terms of the longer term development of learning technology. We are at a very early stage of the use of information and communications technology to support the teaching and learning process. Everyone recognises that it offers great potential but that it is yet to be harnessed. As we learn how to do this, the technology will become better adapted and the teaching and learning process will change - probably in a variety of ways. We are at the beginning of a long journey.

6. References

Note: Dates in square brackets following a URL are the dates the author last visited the URL.

Advanced Distributed Learning project. http://www.adlnet.org/ [8th July 1999]

ARIADNE – Alliance of Remote Instructional Authoring and Distribution Networks for Europe. http://ariadne.unil.ch/ [8th July 1999]

CTI - Computers in Teaching Initiative. http://www.cti.ac.uk/ [8th July 1999]

DfEE - "Department for Education and Employment (1998) Connecting the Learning Society". http://www.dfee.gov.uk/grid/consult/index.htm [8th July 1999]. See also National Grid for Learning. http://www.ngfl.gov.uk/ [8th July 1999]

Dublin Core Metadata Initiative - http://purl.oclc.org/docs/core/index.htm [8th July 1999]

European Union Memorandum of Understanding (MoU): http://www2.echo.lu/telematics/education/en/news/mou.html [8th July 1999]

European Union Standardisation mandate to CEN, CENELEC and ETSI. http://www2.echo.lu/telematics/education/en/news/mou1198/moucen.html [8th July 1999]

Fifth Framework Programme of the European Union. http://www.cordis.lu/fifth/home.html [8th July 1999]

IMS. http://www.imsproject.org/ [8th July 1999]

LTSC - Learning Technologies Standards Committee of the IEEE (formerly P1484 working group). http://ltsc.ieee.org/ [7th July 1999]

TLTP - Teaching and Learning Technology Programme. http://www.ncteam.ac.uk/tltp/ [8th July 1999]

Implementing Virtual Robots in Java3D using a Behavior Based Architecture

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Abstract: New web-based technologies for 3D graphics such as Java3D provide tools for creating autonomous virtual reality agents for educational, entertainment, and simulation software. Such agents need to be responsive and reactive to their environment in order to maintain a steady appearance of behaviors. A behavior based architecture from robotic agent control literature, can provide the basis for these requirements. This paper discusses issues in the design of a virtual reality robot implemented in Java3D and the problems that may be encountered with 3D platforms that provide virtual reality development environments. The virtual robot we describe is able to successfully perform a set of behaviors within its environment. Virtual sensors and actuators are implemented within Java3D, allowing the virtual robot to sense and interact with its environment. Overall performance of the system is taken into consideration.

Introduction

The potential for creating interesting virtual reality based agents has become more feasible with the introduction of various high-level 3D graphics standards for web-based applications. Virtually-embodied autonomous agents can be created using these tools for education, entertainment, and simulation software. The difficulty in creating such agents is providing a robust control architecture which is capable of maintaining the appearance of continuously believable, life-like behavior. An interesting autonomous agent needs to be responsive and reactive to its environment. Furthermore, it should select actions that appear intelligent with regard to its situation. This poses the problem of how to create an autonomous agent that "thinks fast on its feet."

Much work in robotic control architecture research has been devoted to creating fast, reactive agents that are capable of responding to their environment swiftly and in a manner that appears intelligent. The subsumption architecture [Brooks 1985, 1990] and later developments in behavior based architectures [Maes 1994] were specifically designed to create a reactive control system for mobile robots. The subsumption architecture is a computational architecture that allows tight coupling of perception to action via a substrate of computational incremental layers. The substrate consists of networks of augmented timing finite state machines [Brooks 1990]. Thus, the agent is defined by a set of behaviors it exhibits and by the relationship between those behaviors. The appeal of this architecture is that it doesn't rely on planning or complex internal knowledge representation in order to make decisions on what to do next. Instead, the control architecture continuously selects actions for the agent to perform based on the agent's immediate perceptions of its environment and on the agent's current internal state. This allows the agent to react to its environment and provide a steady appearance of life-like behavior.

Using virtual reality to develop such a control architecture is quite advantageous even though behavior based architectures have seen little use in applications involving virtual, rather than physical, robots. Virtual robots can be rapidly and inexpensively reconfigured to create new ones. Similarly, environments can quickly be redesigned to embody different sets of interconnections. Virtual sensors can be created to provide different sensory experiences, such as image capture and processing as a virtual analog to video capture and analysis techniques currently being explored at a hardware and firmware level [Lorigo 1997]. Brooks has argued against the possibility of an adequate simulation of a physical system claiming that complex agent behavior is a reflection of a complex environment and that virtual reality is not rich enough to provide this level of stimulus [Brooks 1992]. Although this viewpoint is valid for the development of real world robots, if an agent's purpose is to ultimately function within a virtual environment, then the most appropriate place for its development is in virtual reality.

This paper describes issues in using Java3D to develop a behavior based architecture similar to Brooks' subsumption architecture for controlling a virtually embodied, rather than physically embodied, autonomous agent. We describe the implementation of a virtual reality robot with insect-like behavior. The virtual robot is designed to incorporate a simple set of behaviors that enables it to wander freely on a playing field but never wander off of the field, avoid other objects while wandering, and return to a nest area after wandering for a sufficient amount of time.

VRML vs. Java3D

In order to concentrate on the behavioral design issues of the agent, it is desirable to use a high-level development framework. Using higher-level abstractions, such as Java3D or VRML is advantageous because they facilitate strong project design. These languages are also attractive because they facilitate an object-oriented approach to design. After making the decision to use a high-level 3D platform for a virtual environment and virtually embodied autonomous agent, it is important to choose one that would support the implementation of the behavior based architecture. Most particularly, the platform needs to support simulated sensory devices and simulated robotic actuators. Two packages worth consideration are the Virtual Reality Modeling Language (VRML) [VRML 1997] and Java3D [Sowizral 1997].

VRML's main advantage is that it is currently the de facto standard for web based 3D visualizations. VRML allows for easy definition of geometric shapes in hierarchical groupings and it also provides many advanced 3D graphics functions such as lighting models and surface materials. VRML allows for simple interactions between a user of a virtual world and the various objects within the world, such as clicking on an object to activate an object's script. VRML is currently well supported with various end-user browser and modeling programs, simplifying the task of both creating and viewing virtual worlds.

There are, however, numerous difficulties in using VRML as a basis for a virtual world that can support interesting autonomous agents. The first problem is the lack of a mature collision handling mechanism within VRML. Although VRML supports collision handling between the user's viewpoint and the scene objects, there is no support for object to object collisions. This creates a serious limitation when trying to implement virtual touch sensors for a VRML-based agent that is viewed from a third person perspective. The second problem with VRML is the relationship between the virtual objects and the VRML browsers. VRML is only a scene description language. In order to create a complex and dynamic environment with VRML, it is necessary to use the Java External Authoring Interface (EAI) [VRML 1999] to programmatically control the visual representation of the environment. Originally developed as an addendum to VRML, EAI does not have a tight enough coupling between the user and the browser to extract useful runtime information about either. Although it is possible to use EAI to determine property and coordinate information about objects in a scene, it is not possible to determine the user's viewpoint or to capture graphical frames from the point of view of a simulated visual sensor.

Java3D provides a purely object-oriented language-based approach for designing 3D systems. Built as an extension to the Java language, Java3D offers a high-level Application Programming Interface (API) for 3D scene description and graphical control. In this sense, it offers some of the same advantages of VRML while also providing tight integration with a fully capable programming language. Furthermore, because it is a Java API, Java3D allows for a fully object-oriented approach to defining and controlling the virtual agent, and its environment. It is capable of providing better integration of three-dimensional content, interface and events within the system. Java3D's sophisticated event model allows for interesting object interactions, such as object to object collisions, as well as a unified interface between timer and scene change events. Java3D is also designed to take advantage of multi-threaded programming techniques, allowing for better performance from the implementation.

Although Java3D provides better mechanisms for the construction and control of a virtual environment, it does present some difficulties. The relative newness of Java3D versus VRML along with its complexity means that development of a system would have to include appropriate measures to train developers in Java3D's use. Also, due to the lack of 3D modeling programs capable of exporting to Java3D, initial environment designs would be simplistic. Java3D also suffers from a lack of support within web browsers. Many of these difficulties are problems regarding technical and implementation issues and are rapidly being overcome. The release version of Java3D includes support for VRML models within a Java3D scene as well as Java plug-in support to include Java3D applets on the web.

Java3D VR-Bot Design

Two different approaches can be taken in the design of the virtual robot using Java3D: event-based and thread performance-based. The first is a strong object-oriented model with object-level event handling. This approach may be taken in order to support hierarchical component abstraction within the system. At the highest level, separate objects encapsulate the functionality of the environment, obstacles on the field, and the virtual robot. This functionality includes methods to retrieve object status and to enact object actions. Any object in the scene is instantiated as a specialized case of a general base object. The virtual robot's construction consists of several sub-objects, including the body, sensor array, individual sensor elements, event handlers, and a visual platform binding for first person navigation of the world. The strong object-oriented model allows for easy reconfiguration of the virtual robot at the base class level and it also provides a useful learning tool, as many are only familiar with physical implementations of behavior based architectures and not Java3D. This model separates the virtual robot from its intermediate control layers, allowing development of different layers to proceed separately.

Although the object model's abstraction does prove advantageous for visualizing the hierarchy and dependencies within the system, it is less than optimal with regard to performance. This could be attributed to non-optimized event handling from the Java3D event system. The abstractions of individual handlers tend to be counterproductive to performance, and the dependency on events does not encourage the exploration of multi-threaded designs. In order to counter these effects, the second approach focuses on the development of a robust thread model to achieve a higher degree of parallel and asynchronous activity. The advantage of this new model is that more reliance is placed on native Java threads that can be managed and optimized manually, rather than Java3D threads to which application programmers have no access.

The major components of this model are the environment, the sensors, the behavior based control architecture, and the robot. The control architecture receives, as input, signals from the sensors whose states change as the environment changes. Signals coming out of the control architecture are interpreted as commands to move the robot around in its environment. The environment consists simply of a few elements: a field, a set of obstacles, target regions, and a set of perimeter markers. The obstacles are there to test the robot's obstacle avoidance behavior, and the perimeter markers are there to test the robot's penning behavior. The robot's obstacle sensors are sensitive to every obstacle on the field, and whenever an obstacle is in a sensor's range, that sensor is made active. Any sensor whose field is empty of objects to which it is sensitive remains inactive. Similarly, the robot's perimeter sensors are sensitive to all the perimeter markers, and their activity status depends on the presence of perimeter markers within their range.

The behavior based architecture itself consists of four behaviors: a wandering behavior, a penning behavior, a homing behavior, and an obstacle avoidance behavior. The wandering behavior's output directs the robot to randomly explore the field, the penning behavior keeps it from wandering off the field, the homing behavior causes the robot to return to a particular location, and the obstacle avoidance behavior keeps it from colliding with obstacles.

The wandering behavior has no input, since arbitrary wandering doesn't require any information. This behavior chooses a direction and then moves in that direction for a random amount of time. After that time runs out, it chooses another direction and starts over. The penning behavior has access to the perimeter sensor array. It polls these sensors, and whenever any of them becomes active, it maneuvers the robot directly away from the vector sum of all active sensor regions. Since only perimeter markers can activate these sensors, this has the effect of moving the robot away from the perimeter when it gets too close. The homing behavior also has access to the perimeter sensor array. When activated, this behavior causes the robot to move in a straight line until it encounters the field perimeter. It then follows the perimeter until it reaches a home station. This behavior would be useful if the robot was collecting objects and depositing them at a nesting location or if the robot had an energy source that needed recharging at a home station. The obstacle avoidance behavior operates in an almost identical fashion as the penning behavior behaves. Whenever any of the obstacle sensors become active, it maneuvers the robot in a direction that is slightly different than directly away from the vector sum of all active sensor regions. A slight random variation is added to this direction because of a special case. If the robot were to wander into a position directly between two obstacles, the obstacle avoidance behavior would calculate their vector sum, find it to be zero, and tell the robot to stand still while suppressing the wandering behavior. Thus the robot would be trapped in that position indefinitely. The random variation in direction assures that the obstacle avoidance behavior isn't continuously telling the robot to not move.

Technical Considerations

The development of this system has brought to light some Java3D issues and difficulties Java3D programmers are likely to face. Foremost of these is a problem involving collision detection. In the current implementation of Java3D, collisions can trigger events. The event model can report the initial entry of an object into a collision state, the removal of an object from a collision state, and the continuance of an object involved in a collision. One of the limitations occurs when two objects are in a collision state and a third one enters. Currently, the Java3D implementation will not indicate that a new collision has occurred. This problem has a direct impact on the implementation of our touch sensor since the use of a single sensor object can not indicate that multiple collisions has occurred. This makes it difficult to determine whether an object is in a sensor's field or not when many objects are moving in and out of it. In order to eliminate this problem, two measures must be taken. First, the sensor region must be divided in into smaller sub-regions, each to be allocated a smaller sensor. This decreases the likelihood of more than one object passing through a sensor region at a time. The quantity of sensors, configuration, and granularity can be adjusted in order to examine the capabilities of the sensor array. Second, each sensor contains information as to what objects in the scene it can sense. After any collision event, a sensor checks to see if it is intersecting any of the objects to which it is sensitive. This extra computation is expensive, and if this multiple collision issue isn't resolved in new releases of Java3D, it could very well defeat the purpose of using Java3D's own collision detection.

Java3D's collision model introduces another difficulty to agent development. Currently there is a lack of separation between the collision engine and the render engine. In the design of a system, it is desirable to defer as much of the interaction with the environment to the Java3D package. This allows Java3D to handle object collisions, since it can perform these operations in a device-independent manner. Although using these pre-built mechanisms simplifies the design task, it does not provide for an optimal model. The difficulty lies in the fact that the current Java3D implementation can not perform off-screen processing. This problem means that the limiting factor for an implementation is the speed of the graphics accelerator, as collision detection and object manipulation require that objects be physically painted to a display device. Not only does this create a bottleneck for simulation, but it also implies that a dynamic world can not continue to operate without a viewer present. To date, we have tested our implementation on two platforms: a Pentium II 300 system with a Matrox Millenium II graphics accelerator, and a Sun Sparc Ultra 60 with a Creator 3D option. On both platforms, profiling indicates that even though simulation timing is controlled by timer events, the graphics pipeline speed creates a ceiling for the computational speed of the system. It is our recommendation that current discussion in the Java3D interest newsgroup [Java 1999] continues to treat off-screen rendering as a high priority in the next release.

Another important consideration in the development of an agent is that of interface and view perspective. During the development process, it is often very important to gain different visual perspectives of the environment. It is sometimes necessary to maintain an overhead view of the simulation field in order to view movements. It is also important to view the profile of the field in order to view collisions and representation issues. In other circumstances, such as simulating visual systems, it would be important to create a view from the perspective of the virtual robot. In order to support these different views, a generalized viewing model for the world must be implemented. The basis of this model includes a viewpoint bound to a null geometry, to act as a "disembodied" point of view. The null geometry of the viewpoint could either be bound to an event handler, such as a keyboard event handler, or to a portion of a pre-existing geometry. By generalizing the interface, one may switch between various perspectives, allowing for both first person and third person visualizations of the world with respect to the virtual robot.

Conclusion

At present we have constructed an autonomous agent that is capable of displaying interesting, reactive behavior in Java3D using a behavior based architecture [Fig. 1]. Using this implementation we are able to demonstrate Arkin's action selection and avoidance algorithms for behavior based agents [Arkin 1998]. We also plan to use it to evaluate Goetz's recurrent behavior networks [Goetz 1997].

Java3D and the Java language platform are in a state of evolution, and many of the difficulties currently encountered due to the language are already scheduled to be addressed in future releases. Java3D provides for many of the elements required by simulated robot systems, including physicality through representational geometry, sensors through event handlers, and action via dynamic changes to the scene graph. Java3D's evolution means that it will be able to address the needs of web based 3D visualizations as well as handle the needs of distributed graphical simulations. Already, there are signs that both of these issues are being addressed, even in a limited fashion. As of this writing, Java3D applications can be run as Java applets over the web via the use of Java plug-in as part of the Java 2 runtime environment. Additional research into the use of distributed Java3D has been stimulated by groups working on shared data abstractions for Java, including the JSDT Development Project at SUN Microsystems [Burridge 1999].

Not only is Java3D appropriate for interests in artificial agent research, but it serves another purpose in that it allows developers to present their work in a manner that is easy to understand. The power provided by Java3D can give a student enough visual stimulation and interactivity to more effectively learn about the nature of behavior based architectures than through a less complex two-dimensional model. The idea of complex emergent behaviors can sometimes be difficult to grasp, but this system is capable of showing students the simplicity of the control architecture's components as well the complexity of the behaviors they produce. Also, Java3D immersive experiences can allow researchers to obtain more insight into their own systems.

There is still much that can be done with this implementation. More behaviors could be added to the control architecture to give the robot a richer set of behaviors. Noise could be added to the sensors in order to test the robot's tolerance for bad data. Also, different behaviors for the architecture could be engineered to fail arbitrarily in order to view the effect such a situation would have on the robot's performance. Due to the virtual nature of this testbed, all of these changes could easily be made, and the effectiveness of the simulation would clearly show any results.

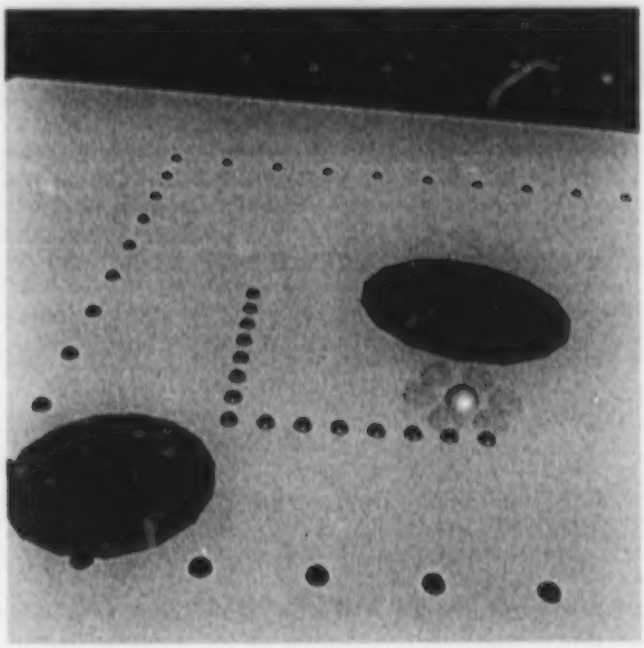

Figure 1: Virtual robot in its environment. The robot (sphere surrounded by six translucent sensor regions) is avoiding obstacles and navigating to fixed positions (circular pads) within the environment.

References

[Arkin 1998] Arkin, R. (1998). *Behavior-Based Robotics*. Cambridge, MA: MIT Press.

[Brooks 1985] Brooks, R. (1985). A Robust Layered Control System for a Mobile Robot. MIT AI Lab Memo 864.

[Brooks 1990] Brooks, R. (1990). Elephants Don't Play Chess. *Robotics and Autonomous Systems*, 6 (1-2): 3-15.

[Brooks 1992] Brooks, R. (1992). Artificial life and real robots. In F. Varela and P. Bourgine (Eds), *Toward a Practice of Autonomous Systems: Proceedings of the First European Conference on Artificial Life*. MIT Press, Cambridge, MA. 3-10.

[Burridge 1999] Burridge, R. (1999). Java Shared Data Toolkit User Guide Version 1.5. Retrieved on February 1, 1999 from the World Wide Web: http://java.sun.com/products/java-media/jsdt/1.5/jsdt-guide/.

[Goetz 1997] Goetz, P., and Walters, D. (1997). The Dynamics of Recurrent Behavior Networks. *Adaptive Behavior*, 6 (2): 247-284.

[Java 1999] Java3D Interest newsgroup. Retrieved on February 1, 1999 from the World Wide Web: http://java.sun.com/products/java-media/mail-archive/3D/index.html.

[Lorigo 1997] Lorigo, L., Brooks, R., and Grimson, W. (1997). Visually-Guided Obstacle Avoidance in Unstructured Environments, *Proceedings of IROS'97*, Grenoble, France. 373-379.

[Maes 1994] Maes, P. (1994). Modeling Adaptive Autonomous Agents. *Artificial Life*, 1 (1-2): 135-162.

[Sowizral 1997] Sowizral, H., Rushforth, K. and Deering, M. (1997). *The Java3D API Specification*. Reading, MA: Addison-Wesley Inc.

[VRML 1997] VRML Consortium. (1997). ISO/IEC 14772-1:1997 The Virtual Reality Modeling Language [Specification]. Retrieved February 1, 1999 from the World Wide Web: http://www.vrml.org/technicalinfo/specifications/vrml97/index.htm.

[VRML 1999] VRML Consortium. (1999). External authoring Interface for VRML [Specification]. Retrieved February 1, 1999 from the World Wide Web: http://www.web3d.org/WorkingGroups/vrml-eai/Specification/

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Parlez-Vous E.C.? An International Perspective of Electronic Commerce

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Abstract: The World Wide Web has become the new shopping medium for many businesses and industries. This paper discusses the current and possible future trends related to international consumer and business to business electronic commerce.

Introduction

The easing of commercial restrictions of the Internet in the 1970's and the evolution of the World Wide Web in the 80's and early 90's has set the stage for the next phase of the Internet: E-Commerce. E-Commerce can be defined as business transactions based on the electronic transmission of data over communication networks such as the Internet (Dryden 1998). It is the communication network and the affordability of such systems that is driving the expansion of E-Commerce, especially in the United States.

Two types of E-Commerce dominate the electronic landscape, consumer and business to business or B2B. Consumer E-Commerce gets more press and attention than business to business, although business to business E-Commerce makes up 80 percent of E-Commerce revenues. This paper discusses the important current and future trends of that affect global E-Commerce.

Who's on-line now

Internationally there are over 100 million Internet users. Approximately 60 million of the connected use the Internet on a daily basis for work, entertainment, shopping, and research. As you can see from chart 1, Internet users from the United States make up 53 percent of the world wide total and 90 percent of all internet users come from only 13 countries, primarily from western European nations. The United Kingdom (UK) and Germany make up 50 percent of all Euro users.

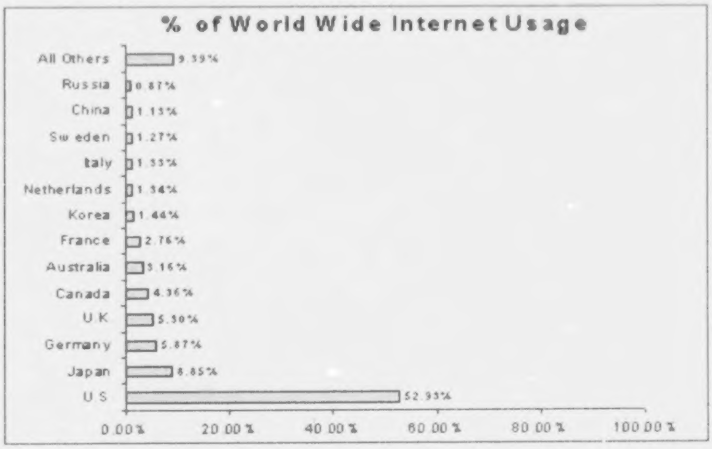

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Chart 1: World Wide Internet Users

According to Henry Heilbrunn, European acceptance of the Internet can be broken down into five levels: 1. highly advanced, 2. coming on quickly, 3. muddling through, 4. not sure because of infrastructure, and 5. emerging. The northern European countries such as Scandinavia are considered to be highly advanced due to a high adopter rate and more centralized Internet planning. The UK and Holland are considered countries that are coming on quickly. UK users make up 30 percent of all Euro connections. In these second level nations the Internet is becoming a true form of mass media. It is predicted that by the year 2000, 50 percent of all people in the UK will be connected. Due to their size and lack of focus France and Germany are considered to be third level countries. In these countries national monopolies for telephone service are making connection financially out of reach for many. In addition to the customary Internet service connection charge, all phone calls are charged on a per minute basis ranging from an equivalent $1.60 - $3.00 / hour. Consumers are so frustrated by the rates that the Association of Unhappy Internauts organized a 24-hour strike in December of 1998. France has also refused to embrace the Internet because of its investment in its antiquated online system Minitel. The French make up only 2 percent of Euro Internet users. The fourth and fifth level countries are primarily southern and eastern European countries.

Five million people in Asia are connected, this number is expected to grow to 10 million by the year 2000. Asian weakness in the Internet community can be attributed to three factors according to Foley (1998): 1 low PC ownership in Japan, 15 percent, 2. China's worry over the Internet as a conduit of politically sensitive material, 3. high poverty levels in many Asian countries. Some commentators suggest that America may be reaching its saturation point, opening the door for Euro and Asian dominance in growth and eventually the Internet market.

Demographic Profile of EC Consumers

The United States is regarded as the earliest adopter of the Internet, subsequently the majority of the web pages on the net are in English and the majority of business is conducted in English. Internationally the majority of users, 77 percent, come from Ireland, UK, Canada, United States, New Zealand, and Australia.

Internationally, Internet users have been predominately young, well- educated, professional, and affluent males. This trend is beginning to change and Internet populations are beginning to be more representative of the entire population. In the United States and Britain, countries leading the way of more representative populations on the Net, female users make up approximately 37 percent Net subscribers. Elsewhere in the world males make up 80 percent of Net users, in Japan 90 percent of the users are male (NOP Research Group 1997). The average age of Internet users in the U.S. and Europe is between thirty and thirty-five years old. As more users come on-line the average age will begin to mirror the general population. Internet households are typically more affluent than the general population, the average income of an Internet household in the U.S. is $55,000 whereas the average U.S. household income falls around $42,000 (Diamond 1997).

Consumer E-Commerce

In 1998 16.8 million American Internet users made at least one purchase on-line. This is 31 percent of all Internet users and 7.8 percent of all Americans 14 and over (eMarketer 1998). Predictions for the 1999 on-line commerce season from the E-Commerce Retail Shopping Report indicate that the number of on-line shoppers will double to 36 million buyers or 16.6 percent of the U.S. population 14 and over. By the year 2002 it is estimated that on-line shopping will swell to 64 million on-line shoppers in the U.S. or 28 percent of the population 14 and over.

World wide, consumer on-line shopping revenues are expected to rise from 1.7 billion dollars in 1997 to more than $35 billion dollars in 2002 as represented in chart 2 . In 1998 the United States accounted for more than 84 percent of worldwide E-Commerce. Predictions indicate that U.S. market dominance will begin to shrink as Europe becomes more Internet E-Commerce connected. If current E-Commerce trends continue the U.S. international market share will shrink to 77 percent by 2002.

In 1998 on-line shoppers in the UK spent 406 million pounds buying goods and services on the Net. This represents 0.2 percent of all UK retail sales, it is expected that UK shoppers will double that amount in 1999. The Verdict report predicts that within five years more than 6 billion pounds worth of goods will be sold over the Internet representing 2.5 percent of all UK retail sales. In 1997 Internet sales in France were almost non-existent, they were in more of an experimental stage. In 1998 more than 50,000 Net shopping sights emerged and French shoppers spent more 3 billion francs (US584 million) this up from 1.2 billion francs (US212 million) in 1997. According to Suzan Nolan of Bluesky International the Europeans are waking up to the potential of the Net not only in terms of profit potential but also in protecting their markets against the American invasion.

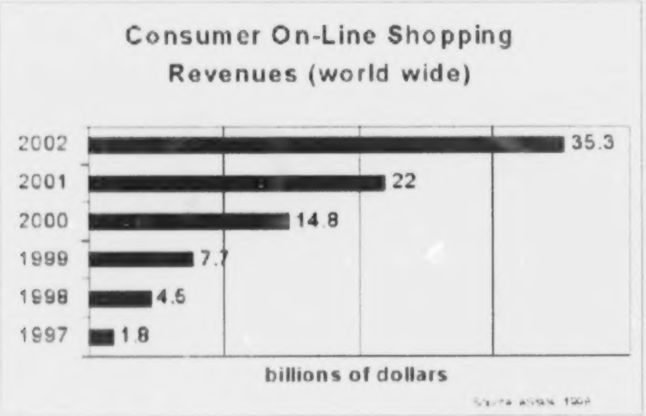


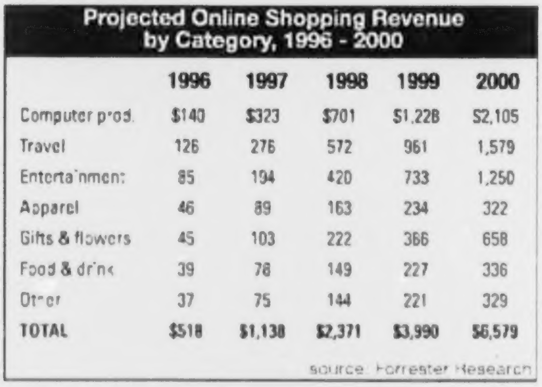
Chart 2: Consumer Online Shopping Revenues

Far more people are using the Internet to assist in making purchasing decisions than actual buying. These "window shoppers" are 33 million strong and use the Net to compare pricing, features, warranties and etc. The question facing Net sellers is how to capitalize on those window shoppers. The interest is there, the next step is convincing people to buy.

Consumer E- Commerce in the U.S. and internationally is on the edge of what may be the first boom of the 21st Century. Electronic commerce at the retail level is fueled by three interrelated "A" factors: Access, Acceptance, and Advantages (eMarketer 1998). Access refers to the number of people connected and it places the upper limit on participation. The number of Americans connected has been steadily increasing over the last decade, whereas the international market is where the U.S. was about five years ago. Access will increase as communication networks, PC technology, and modem technologies become more affordable and efficient. Acceptance refers to the changes in perception, attitude and behaviors related to the Internet. For acceptance to occur people must feel secure in their use of the Internet as a shopping center. On-line users must know that their transactions and personal information are secure. The bandwidth must be available to make the shopping experience an enjoyable and realistic one through the use of richer presentation and demonstration techniques of the goods and services on-line. As people encounter more positive shopping experiences on-line the trust factor of buying on-line will rise as the fear factor decreases. Advantages of e-commerce relate to real and perceived benefits of shopping on-line versus traditional shopping methods. For the advantages to be apparent on-line retailers must ensure that shoppers easily recognize how convenient it is to shop on-line and there are significant benefits for doing so. This may include consumer-centric shopping malls that help with and enhance comparison-shopping, choice, and convenience. As more countries come on-line it is expected that the shopping experience will become a global one increasing the advantages of shopping on-line with more choices. With the expansion of goods and services being available it is also important that more sophisticated front and back end as well as more reliable delivery systems are in place to ensure increased convenience and reliability of shopping on the Internet.

What's Selling On-line

Goods and services selling on the Net can be broken down into seven major categories: 1. Computer products, 2. Travel, 3. Entertainment, 4. Apparel, 5. Gifts and flowers, 6. Other (eMarketer 1998). Computer products, software and hardware, are the most popular products for on-line shoppers. As chart 3 indicates between 1996 and 1998 on-line consumers spent more than $1.1 billion on computer related products. It is predicted that by the year 2000 on-line consumers will spend more than $2 billion on computer related products. Travel is the second most popular service on-line accounting for more than $570 million in on-line sales in 1998, revenues are expected to rise to $1.5 by the year 2000. Entertainment revenues in 1998 totaled $420 million and are expected to increase to $1.2 billion by 2000.



Projected Online Shopping Revenue by Category, 1996 - 2000

	1996	1997	1998	1999	2000
Computer prod.	$140	$323	$701	$1,228	$2,105
Travel	126	276	572	961	1,579
Entertainment	85	194	420	733	1,250
Apparel	46	89	163	234	322
Gifts & flowers	45	103	222	366	658
Food & drink	39	78	149	227	336
Other	37	75	144	221	329
TOTAL	**$518**	**$1,138**	**$2,371**	**$3,990**	**$6,579**

source: Forrester Research

Chart 3: Projected online shopping revenues between 1996 and 2000.

When shopping on-line how much money do shoppers spend at one time? According to Foley's (1998) survey of Web shoppers in 1997, 36 percent spent less than $10, 20 percent spent between $10 and $99 and 29.5 percent spent over $100 on Web purchases. Driving the on-line purchases is convenience, shoppers indicate that the lack of crowds, 24 hour shopping, and not having to wait in line were the major reasons that they had turned to on-line purchasing.

B2B Commerce

Business to business electronic commerce (B2B EC), the very big brother of consumer electronic commerce, does and will continue to rule supreme in the E-Commerce universe. In 1998 consumer E-Commerce totaled $4.5 billion world wide, B2B EC generated $18 billion worldwide. B2B revenues are expected to top $32 billion internationally by the end of 1999. Consumer E-Commerce is expected to rise to only $8 billion in the same time frame.

The United States is the dominate force in the B2B arena, in 1997 the U.S. accounted for $4.7 billion of the $5.6 billion generated world wide. In 1998 the gap widened even further with the U.S. generating $12.5 billion in revenues compared to the $3.4 billion generated by the rest of the international market. According to eMarketer (1998) the U.S. will continue to dominate B2B E-Commerce through the year 2001 as demonstrated in chart 4.

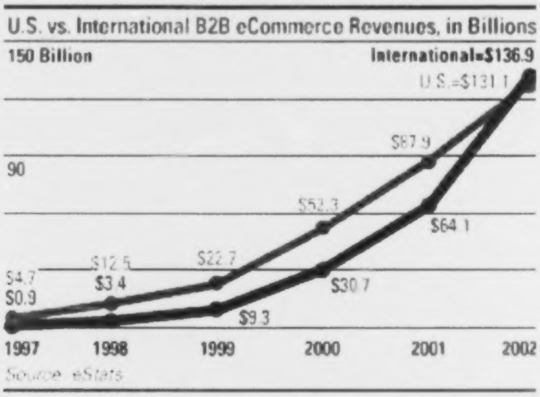


Chart 4: Projected global business to business electronic commerce growth by the year 2002.

It is estimated that the U.S. will generate revenues in excess of $22 billion in 1999, $52 billion in 2000, $87.9 in 2001. International revenues are not expected to exceed U.S. revenues until the year 2002. eMarketer predicts that the U.S. will generate $131 billion in revenues and the International market will generate $136.9 billion.

Business involvement in B2B E-Commerce falls on a continuum ranging from being connected to the Internet to maintaining an active, purposeful web site, and finally to engaging in electronic commerce (eMarketer 1998). At the farthest end of the continuum, business involvement in actual electronic transactions is still very much dependant on the size of the business. As can be seen in chart 5

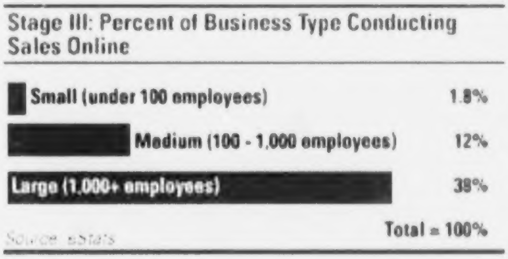


Chart 5: Types and percentages of businesses conducting sales online.

38 percent of "large" businesses are involved in some form of electronic transactions, this drops to 12 percent of "medium" sized businesses, and is only 1.8 percent of '"small" businesses. A lot of this can be attributed to the set-up costs. In 1999 Staples (the office supply super store) is planning on spending $10 million on personal, technology, and marketing to develop a strong B2B web presence for the purpose of conducting on-line sales. It is interesting to note that their budgeting decision is based upon the surge of small businesses being online (the first stage on the B2B continuum). Most small businesses have been taking a "wait and see" attitude in regard to the Internet. As larger businesses have shown the benefits of B2B E-Commerce it is expected that more small businesses will see the advantages of making the initial investment. 1999 is expected to be a very large growth year for small business involvement in B2B E-Commerce by many market analysts.

E.C. Controls

Leading companies from around the world have argued that the Internet should be a self-regulation zone for the time being. In 1995 the Federal Trade Commission called for self-regulation among Web marketers (Bayne, 1998). What has most Internet users worried is the right to privacy, what information can be collected and how it can be used. To avert legislative regulation 50 companies have formed an alliance to promote and set standards that would govern commercial behavior on the Web. Microsoft, Hewlett-Packard, America Online, IBM Corp are the companies spearheading the alliance that has agreed to create privacy guidelines. By introducing and following guidelines many in the industry feel that it would boost public confidence in E-Commerce. The goals of self-regulation would include making sure that the public knew about the regulations, that companies comply with them, and customers would have an avenue available to them in addressing injury resulting from non-compliance.

On the tax front, according to a Forbes report the Internal Revenue Service is very concerned over new encryption software and the creation of electronic money, making it difficult to follow the money trail. In a Department of Treasury document entitled "Tax Policy Implications of Global Electronic Commerce" it is suggested that taxpayers would be required to obtain a digital identification number that would allow the IRS to track electronic transactions and minimize the potential for tax evasion. Another major concern for E-Commerce is that of state and local taxes. It is conceivable that as a transaction bounces across the Internet it could be taxed along the way as it passes through states, cities, and counties. Instead of lobbying for a no tax policy for the Internet, corporations have opened dialogue with states to work on an equitable tax formula. The focus is to create a tax system according to Interactive Services Association that is "uniform, consistent and fair."

Summary and Implications

What's in store for E-Commerce in 1999 and beyond? According to eMarketer (1998) the World Wide Web will truly live up to its name, it is predicted that by the end of the year the number of international Internet subscribers will out number the number of Americans on-line. Their prediction is that the Net population will be 110 million, 56 million residing outside of the U.S. 1999 will be the year of the small business on-line. The middle to large corporations have broken the ice in the B2B arena, leaving a clear and clean path for small businesses to follow. Small business E-Commerce revenues will rise just over 6 percent, giving small business 30 percent of the

E-Commerce market by 2000. Hyperintermediation will be the magnet that brings buyers and sellers together in a mall like atmosphere. As the first of these sites catch on it is predicted that more and more will pop up. These intermediaries will provide shoppers with what they want, convenient and trustworthy one-stop shopping. Although consumer E-Commerce will expand B2B E-commerce will continue to be king of the hill. B2B revenues are expected to top $32 billion by the end of 1999, consumer revenues will top out at $8 billion. To draw the window shoppers into the E-Commerce fold, customer service will be the number one goal of E-Commerce retailers. Speedy delivery, accurate billing, on-line service will be the focus to earn the trust of on-line shoppers. Security questions and concerns will be answered; technologies are advancing at a pace that makes giving out your credit number over the Web safer than giving it out over the phone or counter. By the end of the year over 60 percent of all Internet users in the U.S. will have made at least one purchase on-line, this will be an increase of 27 percent over a year ago.

What implications does the expansion of E-commerce have for higher education? An obvious implication is it is increasingly important that students become Web-savvy. They need to be able to conduct effective and efficient searches utilizing the Internet. In addition, they need be familiar with business uses of the Internet including basic web page design and creation. A not so obvious implication is that exposure to International curriculum (including business, marketing, finance, culture, and humanities) will need to be a part of the core curriculum, not an elective choice. E-Commerce will break down geographic and financial barriers that have limited International trade to larger companies with more resources. Even the small mom and pop business can become involved in International markets using the Internet as their distributor.

"In only five years, the world wide web has emerged as a new channel for consumer shopping which will fundamentally change not only where people buy, but also how, how often, how much, when, what and even why" (eMarketer). "Electronic commerce is set to be one of the driving forces behind the global economy. It is a potentially positive force, which can improve the ways people participate in society as citizens, consumers, workers, and entrepreneurs"(Dryden, 1998).

References

Bayne, K. (1998). Privacy still burning web issue: marketers scramble to come up with self-regulation methods. Advertising Age, 69 (26) p37(1).

Diamond, D. (1997). The web's salon. PC Week Online.

Dryden, J. (1998). Realising the potential of global electronic commerce. *OECD Observer*, 214 p20(5)

ECommerce retail shopping report. (1998) http://www.emarketer.com/estats accessed 1/10/99

ECommerce business report. (1998) Retrieved from the World Wide Web January 10, 1999: http://www.emarketer.com/estats

EMarketer Newsletter Nos. 1-3 (1999) Retrieved from the World Wide Web January 25, 1999: http://www.emarketer.com.

EMarketer Newsletter No.38 (1998) Retrieved from the World Wide Web January 25, 1999: http://www.emarketer.com.

Foley, P., Sutton, D. (1998). Boom time for electronic commerce – rhetoric or reality? Business Horizons pp. 21-28.

French web users call one-day strike a success (1998) http://www.techserver.com accessed 1/25/99.

Heilbrunn, H. (1998) Interactive marketing in Europe. Direct Marketing, 60 (11) p56(4)

Nolan, S. 1999. The yankees are coming! ClickZ Network, Retrieved from the World Wide Web January 25, 1999: http://www.searchz.com

NOP Research Group. (1997) Internet user profile study. Retrieved from the World Wide Web December 2, 1998: http://www.nua.ie/surveys

A VRML and Java-Based Interface for Retrieving VRML Content in Object-Oriented Databases

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Abstract: Storing VRML and VRML-related content in an object-oriented database enables VRML scene authoring with reusable components. A 3D metaphor is designed to search and retrieve these components. The 3D metaphor is realized using VRML and Java. As the 3D interface is integrated in the same VRML scene an author currently has under construction, the query results may be presented in this scene and may be seamlessly used by the author. To achieve this goal, VRML-related content needs to be represented in an object-oriented database. Furthermore, the communication with the database is implemented using a Java applet that also provides an author with authoring features and extracts the authored scene.

1. Introduction

The specification of the Virtual Reality Modeling Language (VRML) [VRML 1997] encourages the use of components to construct complex 3D scene descriptions. There is, e.g. the EXTERNPROTO construct that allows the storage of custom-tailored VRML node descriptions in library VRML files. There is also the inline construct that allows the use of a VRML scene file to build another, more complex VRML scene file. Moreover, certain parts of a VRML scene description are stored in external files with different formats like images, textures, sounds, movies or Java classes.

Thus, a VRML scene file may be created in a fast and cost-effective way, by using predefined components and taking advantage of the benefits of reusability. This is especially true as VRML plays an increasing role as a 3D exchange format. Integrating geometry, animation, interaction behavior, multimedia and hypermedia description, VRML comprises all elements needed to author animation, multimedia applications and virtual environments.

As the number of components rapidly increase when one makes extensive usage of reusability, the problem of efficiently storing, searching and retrieving components arises. These tasks are the realm of database systems which provide solutions for data security, accessibility, consistency, concurrency, recovery and efficiency. Our idea is not only to store VRML components in databases in a suitable manner, but also to make use of VRML and Java to define the human-computer interaction between a VRML scene author and a database. The first major advantage lies in the potential for designing a 3D graphical user interface to the database and making the usage of a database transparent for the author. The second major advantage has to do with the possibility of a seamless presentation of the query results within the VRML environment. Other advantages include the potential to have a distributed, network-based VRML components library that even supports collaborative authoring by two or more authors.

The paper is organized as follows: in the next section, the problems of and requirements for storing VRML and VRML-related content in databases are discussed and the selection of an object-oriented database management system is constituted. The third section describes a suitable 3D database query interface based on VRML, while the fourth section focuses on the presentation and usage of query results. Finally, the implementation of the whole system and our experiences with VRML and Java are the topics of section five.

2. Storing VRML Content in Databases

There has been much effort in the VRML community to link databases and VRML[Walczak 1996]. Research has been conducted on how to embed database query languages like SQL in VRML, especially in a dedicated VRML working group[ET WG 1998]. There are even some applications like data warehousing [Massari 1997] or geographic information integration [Coors 1998] which utilize databases in VRML scenes. Although ways of connecting VRML to databases [Oracle 1998] have been explored (mostly using Java interfaces like the EAI and Java Script Node, as well as JDBC), far less effort has been dedicated to storing VRML itself in a database. In our application scenario, we do not want to visualize information stored in databases, but rather components of VRML scenes that may be used to build VRML scenes more efficiently.

Designing a data model for VRML content is a non-trivial task. A VRML file contains links to other files in the form of URLs. Storing a VRML file as simple text together with its associated files implies an overhead, as data may be stored multiple times. Moreover, the associated files, such as images or sounds, are of interest for VRML authoring itself and should be explicitly accessible, not just via a VRML file in which they are contained. Further, different prototype definitions in the same file should be individually accessible for the use of external prototypes.

Our solution is to parse a VRML file prior to storage. The parsing is not done on node level, it is done for extracting links to other files and prototype definitions. The information gained during parsing is stored seperately and is collected in specific objects. These objects are completed with information about formats (e.g. image formats) and information used for retrieval like keywords, categories, author data, copyright information. Thus, VRML-related content is represented in the database:

1. the content itself is stored in a file system (e.g. an image file, the text that denotes a VRML scene) and
2. an object is constructed that represents meta-data about this content (e.g. the path where the content is stored in the file system, the relationship to other content, the descriptive data).

The first part, the content itself, is stored in the file system as the links to other files and prototype definitions used have to be replaced during parsing in order to retrieve the content without database queries. The database is allowed exclusive access to this part of the file system in order to guarantee consistency.

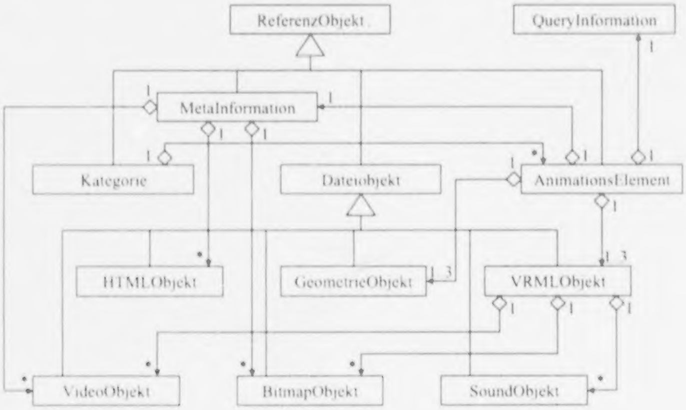

Figure 1: Database scheme (using UML [Fowler 1997])

The natural way to represent the second part, the object graph, is to use an object-oriented database and not to split it up in relations. The classes of the objects used are in an inheritance relation according to the object-oriented paradigm. This leads to the database scheme depicted in [Fig. 1].

3. 3D Database Interface

One of the advantages of VRML lies in the possibility of defining the authoring system in VRML itself. Thus, our idea is to have the interface to the component library in the VRML scene that is currently under construction. Accordingly, the design criteria for conceiving a 3D database interface are:

- Manageability – the interface should have a small, geometrical extension and thus should be handy and convenient to operate. It should be used analogous to a physical tool (e.g. a hammer) to construct the virtual world; for example, the user should be able to lay it down.
- Flexibility – the user should be able to define the search in terms of categories which are important to him. Thus, the categories should be selectable by the user. Information regarding the category in which a component falls is provided during the import process in the database (see Section 2).
- Weighting – the author should be able to express the degree of relevancy a certain category has for his current query
- Browsing – the author should be able to browse the database in order to get an impression of what components are available to him. On the other hand, it should be possible to directly access a certain component.

Considering the design criteria and the metaphors discussed above, a keyword-based approach seems to fit best. The metaphor relies on keywords and consists of two parts. First, the author selects the properties of the component he is interested in by clicking on buttons of a stick-like object (see [Fig. 2]). Steering elements can be found on the top side of the column. Using these elements, the author can initiate a query, redefine the properties he is interested in, and save property selections.

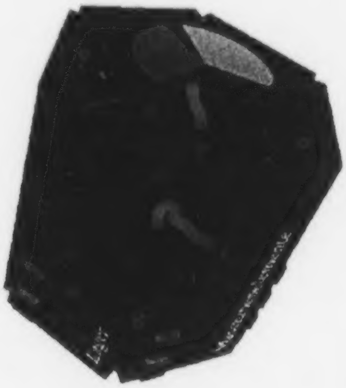

Figure 2: Interface for Property Selection

In the second step, a panel is automatically created for each property selected. The panels are arranged in a circular fashion (see [Fig. 3]) and are labeled with the property name. A dial button can be found on each panel. The dial button may be used in order to weight the relevance of each property for the user. Then, the query can be posted and the results shown beneath the circular object. The user may switch between these two interfaces in order to refine the search. Viewpoints are used in order to present the 3D interface in an optimal way.

4. VRML-Based Presentation Environment

A suitable presentation of the query results should provide a good overview of information relations without an overload of information for the author. If she selects a component this component should be ready to be used for constructing the scene the author is currently working on.

Query results in common search tools are displayed as lists with descriptions of the 3D components or as tables with thumbnails. Often, the components are ordered, showing the best matching results first. In a 2D environment, only a few relations between the components can be displayed.

In a VRML environment, more relations can be shown. The distance between components, or components and keywords, can be used to represent the degree of similarity. For example, in [Hemmje 1994], results are presented on a so-called relevance sphere. The keywords are written on the surface of the sphere and, inside the cone, the query results are shown as symbols. The distance of the symbol to the surface is proportional to the degree of relevance and shows how well the result matches the query. However, a ranking of components cannot be easily recognized in a relevance sphere. Moreover, if a query result matches all keywords, it is near the center of the sphere, regardless of whether it fits well or badly.

Thus, we suggest a linear presentation as shown in [Fig. 3]. Each query result is represented by a scaled element or by a symbol, if not possible otherwise (e.g. behavior description). The relevance value of a query result can be calculated proportional to the similarity of the elements (taking the weights into regard), as well as to the total interest in the properties:

The author can recognize:

- Which components match best regarding all properties
- Which property is fulfilled best
- Whether a component is high-ranking because it matches all properties well or because it matches one property extremely well.

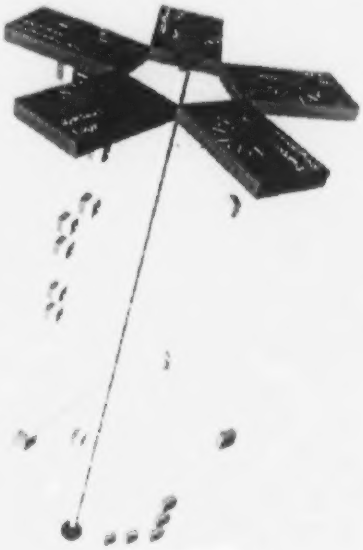

Figure 3: Query Interface and Result Presentation

The author can easily modify the weights using the dial buttons still present in the scene. For a new query, only step 2 has to be executed. Further, the author may determine how many query results are shown by scaling the length of the main axis.

When suitable components have been found, the author will want to use them in her virtual environment. We propose the use of two presentation areas marked with different colors. These can be used for detailed comparisons to elements when unclear which query result to use. If a component is made available at the presentation area, it has been completely represented in the VRML environment. Thus, the component may be immediately used without further database queries. The database makes meta-information available to the authoring system in order to determine how the component is presented to the user and how it may be used by the author. For example, if the meta-information shows "the component currently presented is a texture map", this information may be exploited by the authoring system in that the texture is applied to the next surface the author touches.

5. Design and Implementation Using VRML and Java

Before implementing the database interface, a database was selected and an import tool was designed. The database should be object-oriented and should be accessible via Java. These criteria are fulfilled, for example, by ObjectStore PSE [ObjectStore 1998]. Java classes have been implemented according to the database schema depicted in [Fig. 1]. These classes are used in the database, as well as in the import tool. During import, objects of the corresponding components' class are instanciated and information provided by the user and the parsing of the component are stored. A special parser needs to be written searching for the keywords "url", "PROTO" and "EXTERNPROTO" and integrated in the import tool.

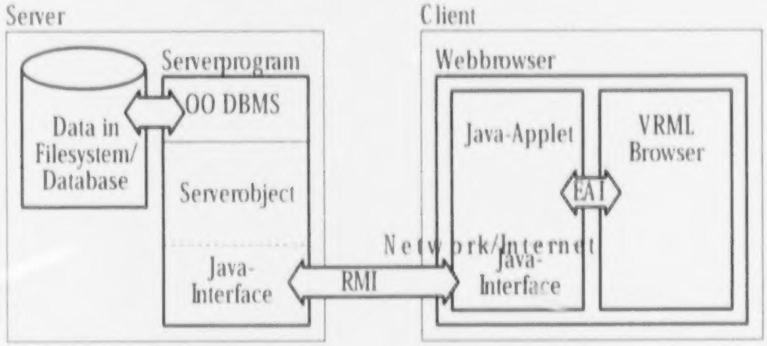

Figure 4: Functionality of the Server Client Connection

The 3D interface is implemented as a Java applet relying on different Java APIs like the remote method invocation API (RMI) [Gosling 1996] and the VRML external authoring interface (EAI) [EAI WG 1998]. The functionality of the applet is rather complex (see [Fig. 4]).

1. it establishes a connection to the database and translates the query information gained from the 3D interface to database queries submitted via network (using RMI) to the database. The query results are received by the applet and made available to the VRML scene.

2. The applet implements the behavior of the 3D query and presentation interface, e.g. how many properties need to be displayed on the graphical representation of the 3D interface. Here, the EAI is used in order to control a VRML browser, manipulate the scene and observe the scene for events.

3. The applet provides authoring features. It allows the user to place, arrange or apply components retrieved from the database in the scene in a component-specific way. For instance, if a sound component is retrieved, the applet will not only play the sound, but has to assure that the sound is represented graphically as a 3D icon. This is the prerequisite to the author attaching the sound to an object or modifying sound parameters.

4. If the author has finished constructing the scene, the applet has to write the authoring result to a VRML file. Therefore, the applet has to accomplish the inverse task of the "CreateVrmlFromString" method of the EAI, i.e. it has to transform the scene graph dynamically created in the VRML browser into a text representation. In addition, as the 3D database interface and its functionality are part of the very scene that was authored, the authoring result needs to be extracted from the entire scene.

6. Conclusion and Further Work

In this paper, we described a 3D interface metaphor to a database of VRML-related content. The interface may be used to search the VRML-related content for components needed to construct a VRML scene efficiently. As the 3D interface is integrated in the same scene an author currently has under construction, the query results may be presented in this scene and seamlessly used by the author.

Technically, we described how VRML content is stored in an object-oriented database. The features of the Java applet which control the VRML scene, communicate with the database, and extract the authoring results were also presented.

Due to its ability to describe all types of components necessary for authoring a 3D environment, VRML proved to be well-suited as a format for storing reusable components. From an application point of view, VRML can be improved by explicitly declaring all components used in a VRML scene description. The external authoring interface used as an interface between VRML and Java could be extended by a method that traverses a VRML scene graph and outputs the scene graph in text format. Furthermore, no support for the administration of references to dynamically created nodes is present in the EAI. This enforces the scene graph being represented in Java, as well.

In future work, the 3D database interface is to be integrated in a full-featured authoring tool that, for example, visualizes the scene graph or is not limited to the usage of elements that are already present in the database. The most challenging task, however, is to find a standardized description and classification of the content that enables the user to specify fuzzy queries.

7. Literature

[1] Coors, V., and V. Jung. (1998). Using VRML as an Interface to the 3D Data Warehouse. *Proceedings VRML 98 Third Symposium on the Virtual Reality Modeling Language*, pp.: 121 – 127

[2] Fowler, M., and K. Scott. (1997). *UML Distilled : Applying the Standard Object Modeling Language*, Addison-Wesley, ISBN: 0201325632

[3] Gosling, J., Joy, B., and G. Steel. (1996). *The Java Language Specification*, http://java.sun.com/docs/books/jls/html/index.html

[4] Hemmje, M., Kunkel, C., and A. Willett, A. (1994). *LyberWorld - A Visualization User Interface Supporting Full Text Retrieval*, In Proceedings of the 17th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, Dublin, pp.: 249-258

[5] Information for ObjectStore PSE. (1998). Homepage of Object Design Inc.: http://www.odi.com

[6] Luckas, V., and T. Broll. (1997). *CASUS – An Objekt-Oriented Three-Dimensional Animation System for Event-Oriented Simulators*, Proceedings of Computer Animation 97, Geneva

[7] Massari, A., Saladini, L., Hemmje, M., and F. Sisinni. (1997) *Virgilio: A Non-Immersive VR System to Browse Multimedia Databases*, Multimedia, Computing and Systems '97. Proceedings., IEEE International Conference on, pp.: 573 - 580

[8] Oracle Corporation. (1998). *Oracle Worlds*, http://www.olab.com/vrml/vrml.html

[9] Enterprise Technology Working Group. (1998). The VRML Konsortium. http://www.vrml.org/WorkingGroups/dbwork

[10] External Authoring Interface Working Group. (1998). The VRML Konsortium. http://www.vrml.org/WorkingGroups/vrml-eai

[11] The Virtual Reality Modeling Language. (1997). The VRML Konsortium. http://www.vrml.org/Specifications/VRML97/index.html

[12] Walczak, K. (1996). *Integration of Virtual Reality and Multimedia Data in Databases*, Multimedia Database Management Systems, Proceedings of International Workshop on , pp.: 80 - 84

A Hybrid CD-ROM/Internet Introduction to Music Course

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Abstract: This pater attempts to describe the design of courseware for a self-paced, non-major music course, and a novel method for its delivery. The courseware for this course was designed as a stand alone, self-paced, computer mediated, interactive, multimedia program. Its central didactic objective is to develop in the learner skills needed to cognize auditorily details of structure in a composition and thereby attain some cognition of form in music without the use of musical notation. Learning takes place in a 'virtual class' and the Internet serves as a communication vehicle between students and instructor as well as between students and their peers.

POW! Perspectives On the Web

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Abstract: The perspectives mechanism described in this paper provides a flexible approach to organizing information in a shared repository for the use of individuals and groups engaged in collaboratively constructing knowledge. The perspectives approach builds on a long history of ideas for personalizing access to information within large hypertext spaces, but the POW! perspectives server is the first example of implementing this approach on the WorldWideWeb. After reviewing the concept of perspectives as a support mechanism for Web-based collaboration, this paper will present the main features of the approach and describe common functional types of perspectives. The POW! perspectives server is currently being used in two educational applications: one an environmental course in middle school and the other a graduate seminar in cognitive science. These two collaborative learning applications will be discussed briefly. At the WebNet '99 Conference, evaluation results from these two courses will also be presented.

1. Perspectives: A Collaboration Support Mechanism

The concept of perspectives comes from the hermeneutic philosophy of interpretation of Heidegger (1927) and Gadamer (1967). According to this philosophy, all understanding is situated within interpretive perspectives: knowledge is fundamentally perspectival. This is in accord with recent work in cognitive science that argues for theories of socially situated activity and collaborative learning (e.g., Lave & Wenger, 1991; Winograd & Flores, 1986).

Collaborative work typically involves both individual and group activities. Individuals engage in personal *perspective-making* and also collaborate in *perspective-taking* (Boland et al., 1995). That is, people and communities construct not only elements of domain knowledge, but also their own "take" on the domain, a way of understanding the network of knowledge that makes up the domain. An essential aspect of making one's perspective on a domain of knowledge is to take on the perspectives of other people in the community. Learning to interpret the world through someone else's eyes and then adopting this view as part of ones own intellectual repertoire is a fundamental mechanism of learning. Collaborative learning can be viewed as a dialectic between these two processes of perspective making and perspective taking. This interaction takes place at both the individual and group levels of analysis – and it is a primary mode of interchange between the two levels.

While the Web provides an obvious medium for collaborative work, it provides no support for the interplay of individual and group understanding that drives collaboration. First, we need ways to find and work with information that matches our personal needs, interests, and capabilities. Then we need means for bringing our individual knowledge together to build a shared understanding and collaborative products. Enhancing the Web with perspectives may be an effective way to accomplish this.

As a mechanism for computer-based information systems, the term *perspective* means that a particular, restricted segment of an information repository is being considered, stored, categorized, and annotated. This segment consists of the information that is relevant to a particular person or group, possibly personalized in its display or organization to the needs and interests of that individual or team. Computer support for perspectives allows people in a group to interact with a shared community memory; everyone views and maintains their own perspective on the information without interfering with content displayed in the perspectives of other group members.

One problem that typically arises is that isolated perspectives of group members tend to diverge instead of converging as work proceeds. Structuring perspectives to encourage perspective-taking, sharing, and negotiation offers a solution to this by allowing members of a group to communicate about what information to include as mutually acceptable. The problem with negotiation is generally that it delays work on information while potentially lengthy negotiations are underway. Here, a careful structuring of perspectives provides a solution, allowing work to continue within personal perspectives while the contents of shared perspectives are being negotiated. We believe that perspectives structured for negotiation is an important approach that can provide powerful support for collaborative use of large information spaces on the Web.

The idea of Perspectives On the Web traces its lineage to ideas like "trail blazing" (Bush, 1950), "transclusion" (Nelson, 1981), and "virtual copies" (Mittal et al., 1986) – techniques for defining and sharing alternative views on large hypertext spaces. At the University of Colorado, we have been building desktop applications with perspectives for the past decade (McCall et al., 1990; Stahl, 1993a). With the implementation of the POW! perspectives server we can now use perspectives on the Web.

2. Features of the Perspectives Mechanism

The perspectives mechanism that we have been exploring (Stahl, 1993b) incorporates the following features for a community of users:

- Individual community members have access to what appears to be their own information source. This is called their *personal perspective*. It consists of items from a shared central information repository that are tagged as being visible within that particular perspective (or in any perspective inherited by that perspective). This provides a workspace for perspective-making.
- Community member A can integrate an item from B's perspective into A's personal perspective by creating a *link* (or virtual copy) of the item. If B modifies the original item, then it changes in A's perspective as well. However, if A modifies the item, a new item is actually created for A with the modified content, so that B's perspective is not changed. This arrangement generally makes sense because A wants to view (or inherit) B's item, even if it evolves. However, B should not be affected by the actions of someone who copied one of B's items.
- Alternatively, A can *physically copy* the contents of an item from B's perspective. In this case, the copies are not linked to each other in any way. Since A and B are viewing physically distinct items now, either can make changes without affecting the other's perspective. Linking and copying notes from other perspectives allows perspective-taking to occur.
- When A creates a virtual copy of an item from B's perspective, A can decide if she will also get virtual copies of items related to that one, or if she will create her own sub-network for her copy of that item. Arbitrarily large sub-networks of information can be inherited with no overhead using the linking and inheritance mechanisms.
- Items of information can be created, edited, rearranged, linked together, or deleted by users within their personal perspective without affecting the work of others.
- There is an inheritance tree of perspectives; descendants inherit the contents of their ancestor perspectives. Changes (additions, edits, deletions) in the ancestor are seen in descendent perspectives, but not vice versa.
- New perspectives can be created by users. Perspectives can inherit from one or more existing perspectives. Thus, a team perspective can be created that inherits all the content of the perspectives of the team's members. A hierarchy of team, sub-team, and individual perspectives can be built to match the needs of a particular community.

This model of perspectives has the important advantage of letting team members inherit the content of their team's perspective and other information sources without having to generate it from scratch. They can then experiment with this content on their own without worrying about affecting what others see. This is advantageous as long as one only wants to use someone else's information to develop one's own perspective.

However, if one wants to influence the content of team members' perspectives, then this approach is limited because one cannot change someone else's content directly. This limitation is overcome with the linking/copying functions and the definition of certain types of perspectives, as discussed below. It is of course important for supporting collaborative work that the perspectives maintain at least a partial overlap of their contents in order to reach successful mutual understanding and coordination. The underlying subjective opinions must be intertwined to establish intersubjective understanding (Tomaselo et al., 1993; Habermas, 1981). When we set up a new application using POW!, we structure an initial hierarchy of perspectives to support both divergent and convergent discourse among perspectives. The innovation in our collaboration applications – compared for instance to CSILE (Scardamalia & Bereiter, 1991) – is the flexible perspectives mechanism, in which content is automatically inherited down a hierarchy of perspectives and in which this hierarchy can itself evolve to meet changing user needs.

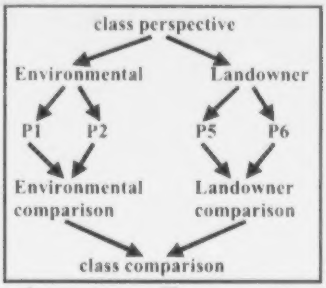


Figure 1. A typical inheritance hierarchy of perspectives. The comparison perspective includes all content from member perspectives. Results of negotiation can be added to class and team perspectives to be shared in all members' personal perspectives.

3. Types of Perspectives and Practices

A typical POW! application provides several functional types of perspectives within a multi-layered graph of perspective inheritance to help students compile their individual and joint research (Figure 1). Certain social practices for using the application are associated with these different types of perspectives:

The *class perspective* is created by the teacher to start everyone off with some initial pointers and suggested topics. It typically establishes a structure for classroom activities and provides a space for collecting the products of collaborative intellectual work.

Team perspectives contain items that have been accepted by the members of a team. This perspective is pivotal for collaboration; it gradually collects the products of a team's effort.

A student's *personal perspective* is a private work space for constructing the student's personalized perspective on the shared information. It inherits a view of everything in team perspectives of the teams to which the student belongs. Thus, it displays the owner's own work within the context of items proposed or negotiated by teams and the class – as modified by the student. Students can each modify (add, edit, delete, rearrange, link) their copies of team items in their personal perspectives. They can also create completely new material there.

The *comparison perspective* combines all the personal perspectives of team members and the team perspective, so that anyone can compare all the work that is going on. It inherits from the personal, team, and class perspectives. Students can go here to get ideas and copy items into their own personal perspective or propose items for a team perspective.

Students each enter notes in their personal perspective using information available to them: the Web, books, encyclopedia, CD-ROM, discussions, or other sources. Students can review the notes in the class perspective, their team perspectives, and the personal perspectives of their team mates. All of these contents are collected in comparison perspectives, where they are labeled by their perspective of origin. Students extract from any of these perspectives those items which are of interest to them. Then they organize and develop the data they have collected by categorizing, summarizing, labeling, and annotating. The stages of investigating, collecting, and editing can be repeated as many times as desired. Team members then negotiate which notes should be promoted to the team perspective to represent their collaborative product.

The class project ends with each team producing an organized perspective. This year's research products can be used to create next year's class perspective starting point, so new researchers can pick up where the previous generation left off – within a Web information space that will have evolved substantially in the meantime.

4. Negotiating Environmental Perspectives

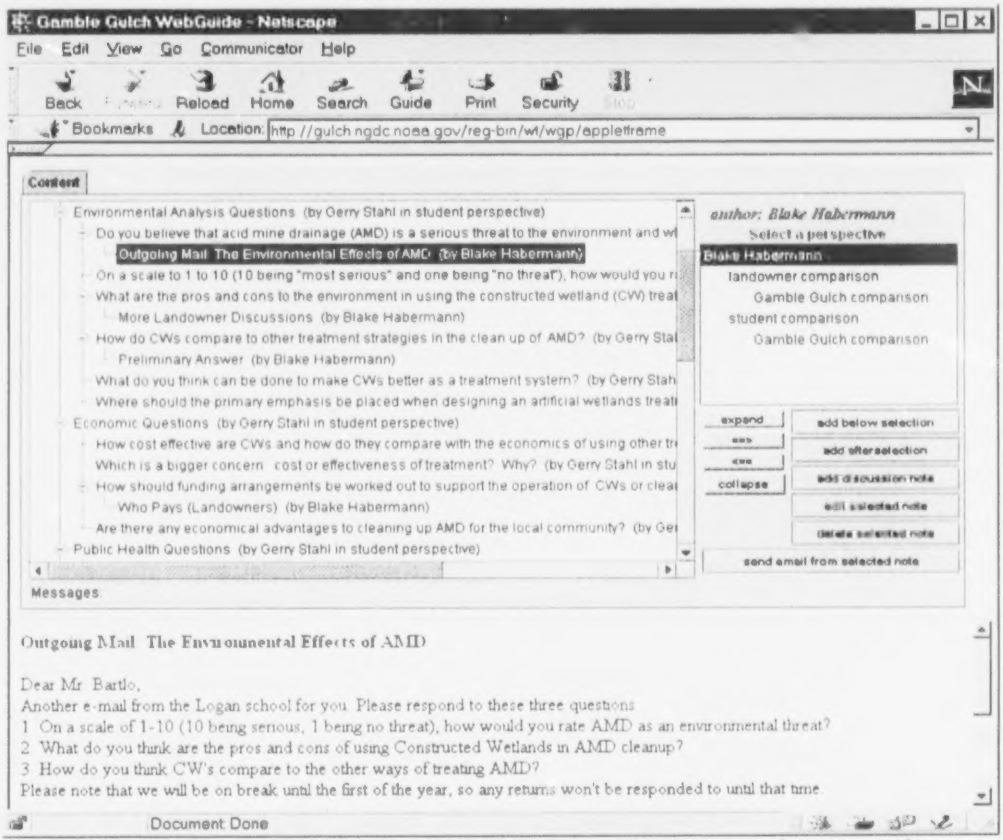
This Fall we piloted the use of POW! in a classroom at the Logan School for Creative Learning in Denver, using both HTML and Java applet interfaces to the perspectives server. For the past five years, this class of middle school students has researched the environmental damage done to mountain streams by "acid mine drainage" from deserted gold mines in the Rocky Mountains above Denver. They actually solved the problem at the source of a stream coming into Boulder from a mine site by building a wetlands area to filter out heavy metals. This year they are investigating the broader ramifications of their past successes; they are looking at the issue of acid mine drainage from various alternative – and presumably conflicting – perspectives. The students interview adult mentors to get opinions from specific perspectives: environmental, governmental, mine-owner, and local landowners.

The POW! application serves as a medium through which students collaboratively research these issues with their mentors and with each other. Each student and mentor has their personal perspective, and these perspectives inherit from one of the content-based team perspectives (environmental protection, governmental regulation, etc.), depending upon which intellectual perspective they are working on constructing. Even email interactions happen through the application and are retained as notes in its perspectives.

A tree of discussion threads was "seeded" in the application with question categories, such as "Environmental Analysis Questions". Within these categories, the teacher posted specific questions for the students to explore, like, "Do you believe that acid mine drainage is a serious threat to the environment?" Students can send an email to one or more mentors asking for information related to this question. When replies are sent back, they will be automatically posted to the discussion thread under the original email. When someone clicks on a title in the discussion, the contents of that item are displayed in an HTML frame below the applet (Figure 2).

A student works in her personal perspective, which might inherit from the class, student team, and landowner team perspectives. She can add, edit, and delete ideas in her perspective, as well as sending email in it. Because she is a member of the landowner team and the student group as well as the class, she can browse ideas in the student team comparison, the landowner team comparison, and the class comparison perspective.

For this application, the teacher has decided that negotiation and perspective-taking will take place in live classroom discussions, rather than within the Web application. After a team or the whole class reaches a consensus, the teacher will enter the statements that they have agreed to into the team or class perspective.


Gamble Gulch WebGuide - Netscape
File Edit View Go Communicator Help
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Bookmarks Location: http //gulch ngdc noaa gov/reg-bin/wt/wgp/appletframe
Content
author: Blake Habermann
Select a perspective
Blake Habermann
landowner comparison
Gamble Gulch comparison
student comparison
Gamble Gulch comparison
expand
==>
<==
collapse
add below selection
add after selection
add discussion note
edit selected note
delete selected note
send email from selected note
Messages
Document Done

- Environmental Analysis Questions (by Gerry Stahl in student perspective)
  - Do you believe that acid mine drainage (AMD) is a serious threat to the environment and wi
    - Outgoing Mail The Environmental Effects of AMD (by Blake Habermann)
  - On a scale to 1 to 10 (10 being "most serious" and one being "no threat"), how would you ra
  - What are the pros and cons to the environment in using the constructed wetland (CW) treat
    - More Landowner Discussions (by Blake Habermann)
  - How do CWs compare to other treatment strategies in the clean up of AMD? (by Gerry Stal
    - Preliminary Answer (by Blake Habermann)
  - What do you think can be done to make CWs better as a treatment system? (by Gerry Stah
  - Where should the primary emphasis be placed when designing an artificial wetlands treat
- Economic Questions (by Gerry Stahl in student perspective)
  - How cost effective are CWs and how do they compare with the economics of using other tr
  - Which is a bigger concern cost or effectiveness of treatment? Why? (by Gerry Stahl in stu
  - How should funding arrangements be worked out to support the operation of CWs or clea
    - Who Pays (Landowners) (by Blake Habermann)
  - Are there any economical advantages to cleaning up AMD for the local community? (by Ge
- Public Health Questions (by Gerry Stahl in student perspective)

Outgoing Mail The Environmental Effects of AMD

Dear Mr Bartlo,
Another e-mail from the Logan school for you Please respond to these three questions
1 On a scale of 1-10 (10 being serious, 1 being no threat), how would you rate AMD as an environmental threat?
2 What do you think are the pros and cons of using Constructed Wetlands in AMD cleanup?
3 How do you think CW's compare to the other ways of treating AMD?
Please note that we will be on break until the first of the year, so any returns won't be responded to until that time.

Figure 2. An interface to the POW! perspectives server. A Java applet shows a student notes in his personal perspective. An HTML frame below displays the content of a selected note.

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The goal of the year-long course is not only to negotiate within teams to construct the various positions, but also to negotiate among the positions to reach consensus or to clarify differences. The teacher designed this class to teach students that knowledge is perspectival, that different people construct views, compilations of facts, and arguments differently depending upon their social situation. He hopes that his students will not only learn to evaluate statements as deriving from different perspectives, but also learn to negotiate the intertwining of perspectives to the extent that this is possible.

As an initial field testing of our system, this trial has resulted in valuable experience in the practicalities of deploying such a sophisticated program to young students over the Web. The students are enthusiastic users of the system and offer (through the application) many ideas for improvements to the interface and the functionality. Consequently, the software is benefiting from rapid cycles of participatory design. The differing viewpoints, expectations, and realities of the software developers, teachers, and students provide a dynamic field of constraints and tensions within which the software, its goals, and the understanding of the different participants co-evolve within a complex structural coupling.

5. Constructing Perspectives on Computer Mediation

We have also recently begun an interdisciplinary graduate seminar on computer mediation of collaborative learning. The seminar uses a POW! application in several ways:

- *As the primary communication medium for their internal collaboration.* The seminar takes place largely on-line. Limited class time is used for people to get to know each other, to motivate the readings, to introduce themes that will be followed up on-line, and to discuss how to use the software within the seminar.
- *As an example system of computer-mediated collaboration to analyze.* Highly theoretical readings on mediation and collaboration are made more concrete by discussing them in terms of what they mean in a system like ours. The advantage of using a locally-developed prototype as our example is that we not only know how it works in detail, but we can modify its functionality or appearance to try out suggestions that arise in the seminar.
- *As an electronic workspace for members to construct their individual and shared ideas.* Ideas entered into the system persist there, where they can be revisited and annotated at any time. Ideas that arise early in the seminar will still be available in full detail later so that they can be related to new readings and insights. The record of discussions over a semester or a year will document how perspectives developed and interacted.
- *As a glossary and reference library.* This application is seeded with a list of terms that are likely to prove important to the seminar and with a list of seminar readings. Seminar members can develop their own definitions of these terms, modifying them based on successive readings in which the terms recur in different contexts and based on definitions offered by other members. Similarly, the different readings can be discussed and interpreted on-line.
- *As a brainstorming arena for papers.* The application has already been seeded with themes that might make interesting research papers drawing on seminar readings and goals. It allows people to link notes from anywhere in the information environment to these themes and to organize notes under the themes. Thus, both individuals and groups can use this to compile, structure, and refine ideas that may grow into publishable papers. Collaborative writing is a notoriously difficult process which generally ends up being dominated by one participant's perspective or being divided up into loosely connected sections, each representing a single perspective. Software with perspectives may facilitate a more truly collaborative approach to organizing ideas on a coherent theme.
- *As a bug report mechanism or feature request facility.* Seminar participants can communicate problems they find in the software as well as propose ideas they have for new features. By having these reports and proposals shared within the Web-based medium, they are communicated to other seminar participants, who can then be aware of the bugs (and their fixes) and can join the discussion of suggestions.

The seminar version of POW! incorporates a built-in permissions system that structures the social practices surrounding the use of the system. Seminar participants each have a home personal perspective in which they can manipulate notes however they like without affecting the views in other perspectives. They can add quick discussion notes or other kinds of statements. They can edit or delete anything within their home perspective. They can also make multiple copies or links from notes in their personal perspective to other notes there. Anyone is free to browse in any perspective. However, if one is not in ones own perspective then one cannot add, edit, or delete notes there. To manipulate notes freely, one must first copy or link the note into ones own personal perspective. The copy or link can optionally include copying (or linking) all the notes below the selected note in the tree as well. These rules are enforced by the user interface, which checks whether or not someone is in their personal perspective and only allows the legal actions.

The fact that an individual note may have different edited versions and different linking structures in different perspectives, that notes may have multiple parents within a discussion thread, that new perspectives can be added dynamically and may inherit from multiple other perspectives sets our systems apart from simple threaded discussion media. It also makes the computations for displaying notes rather complex. This is a task that definitely requires computers. By relieving people of all this bookkeeping, computer support may help people to collaborate.

The seminar application emphasizes the use of perspectives for structuring collaborative efforts to build shared knowledge. The goal of the seminar is to evolve sophisticated theoretical views on computer mediation within a medium that supports the sharing of tentative positions and documents the development of ideas and collaboration over time. A major hypothesis to be explored by the course is that software environments with perspectives can provide powerful tools for coordinated intellectual work and collaborative learning. For instance, it will explore how the use of a shared persistent knowledge construction space can support more complex discussions than ephemeral face-to-face conversations. We will explore the effectiveness of this application as a computationally-active tool to augment the knowledge construction work of a community, and report our findings at WebNet '99 in the Fall.

6. References

[Boland & Tenkasi 1995] Boland, R. J. Jr. & Tenkasi, R. V. (1995) Perspective making and perspective taking in communities of knowing. *Organization Science*. Vol. 6, No. 4, 350-372.

[Bush 1950] Bush, V. (1950) As we may think. *Atlantic Monthly*. Vol. 176, No. 1, 101-108.

[Gadamer 1967] Gadamer, H-G. (1967) *Truth and Method*. Crossroad Books.

[Habermas 1981] Habermas, J. (1981) *Theorie des kommunikativen Handelns. Band 1. Handlungsrationalität und gesellschaftliche Rationalisierung*. Suhrkamp Verlag.

[Heidegger 1927] Heidegger, M. (1927) *Being and Time*. Harper & Row.

[Lave & Wenger 1991] Lave, J. & Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press.

[McCall et al. 1990] McCall, R., Bennett, P., d'Oronzio, P., Ostwald, J., Shipman, F., Wallace, N. (1990) Phidias: Integrating CAD graphics into dynamic hypermedia. *ECHT '90*. 152-165.

[Mittal et al. 1986] Mittal, S., Boborow, D., Kahn, K. (1986) Virtual copies at the boundary between classes and instances. *OOPSLA '86 Proceedings*. 159-166.

[Nelson 1981] Nelson, T. (1981) *Literary Machines*. Mindful Press.

[Scardamalia & Bereiter 1991] Scardamalia, M. & Bereiter, C. (1991) Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences*, 1, 37-68.

[Stahl 1993a] Stahl, G. (1993a) Supporting situated interpretation. *Proceedings of the Cognitive Science Society 1993*. 965-970.

[Stahl 1993b] Stahl, G. (1993b) *Interpretation in Design. The Problem of Tacit and Explicit Understanding in Computer Support of Cooperative Design*. Unpublished Ph.D. Dissertation. Department of Computer Science. University of Colorado at Boulder. Chapter 9 on "Interpretive perspectives for collaboration" available at http://www.cs.colorado.edu/~gerry/publications/dissertation/Ch09.html.

[Tomasello et al. 1993] Tomasello, M., Kruger, A. C. & Ratner, H. (1993) Cultural learning. *Behavioral and Brain Sciences*. 495-552.

[Winograd & Flores 1986] Winograd, T. & Flores, F. (1986) *Understanding Computers and Cognition*. Addison-Wesley.

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Using Intranet Agents to Capture Tacit Knowledge

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Abstract: People can easily determine whether or not a given document is interesting just by glancing through it. However, when asked to explicitly list the rules upon which such a decision is based, they are unable to do so. This is because our personal interests are examples of tacit knowledge. I have implemented a prototype agent-based retrieval system, capable of finding web documents matching a user's interests and connecting users with similar profiles. Based on empirical findings from this prototype I claim that agent-based retrieval systems may be used to capture our professional interests, thus making otherwise elusive tacit knowledge tangible. By using agent-based retrieval systems two otherwise troublesome obstacles are avoided: interests may be defined by examples instead of specific keywords, and there now exists a natural incentive for creating and maintaining a search profile.

1. Introduction

Epistemologically, knowledge can be split along several dimensions. One way, as suggested by [Polanyi 1966], is to distinguish between tacit knowledge and explicit knowledge. Though others have since explored this separation in greater detail, I shall stay with Polanyi's definition for the scope of this paper. By explicit knowledge, I mean knowledge that has been captured and codified into manuals, procedures, and rules, and when using the phrase tacit knowledge, I refer to knowledge that cannot be easily articulated and thus only exists in people's bodies and minds.

An interesting but also troublesome property of tacit knowledge is the inherent tension between its value and its elusiveness. The high value stems from the fact that most of the body of knowledge is made up of things we know but are unable to express. Michael Polanyi explains: "We can know more than we can tell" [Polanyi (1966) 1998]. One of the objectives of Knowledge Management is to bridge the gap between tacit and explicit knowledge, and any technological solution that could assist in this process would be highly appreciated.

The elusiveness of tacit knowledge can be derived from at least two reasons; we are ourselves not fully aware of it, and there is a lack of inventive on the individual level to make it explicit. First, tacit knowledge "incorporates so much accrued and embedded learning that its rules may be impossible to separate from how an individual acts" [Davenport & Prusak 1997, p.70]. In our daily activities, our tacit knowledge governs our activities without us thinking of it as knowledge. We know how to ride a bike, or what cinnamon smells like, but we cannot document it in a manual, nor explain it to others.

Second, our knowledge is something that resides within us, and manifests itself through our actions, and we therefore have no reason to document it. We just use it. Should we have to express our tacit knowledge in words, it would not be for our own sake but for the benefit of someone else in our organisation or community. [Grudin 1987] has argued convincingly that situations where one is forced to do the work and someone else gets the benefit very often result in failure.

Our interests are an instance of tacit knowledge. Though we may be unable to produce an exhaustive definition of our interests, we usually have no problem in determining whether or not any given document is interesting. Therefore, we intuitively know what we are interested in when we see it but we are unable to make our interests explicit for others to learn. Yet our professional interests govern much of our daily office activities. It dictates what reports we read, which documents we write, which discussions we engage in, and what we search for on the web. If we could somehow capture some of those activities and derive our underlying interests, we might be able to externalise some of our tacit knowledge, and thus make it - if not explicit - at least "touchable". Such a possibility would be useful to an organisation, as it would enable people to locate knowledge instead of only information.

I argue that agent-based web retrieval systems can be used to solve the two problems mentioned above; they help articulate tacit knowledge, and they create an incentive to try to do so. By identifying certain documents as interesting, an agent-based retrieval system could maintain a dynamic profile that represents some of my tacit knowledge without requiring explicitly defined keywords or manually updated records. Since this profile is used to provide me with information that is more accurate and search results that are more precise, a natural incentive exists for me to give feedback and thus cultivate the profile. The resulting profile, as I will show, represents part of my tacit knowledge, which in a sense becomes tangible.

Research concerning agent-based retrieval systems has focused mainly on user-to-object or user-to-information objectives, but has sometimes also addressed the user-to-user considerations. See e.g. [Resnick & Varian 1997] or [Fagrell & Ljungstrand 1998] for references to various recommender systems and their implementations. No one, however, has approached agent-based retrieval systems from a knowledge management perspective; i.e. discussed what knowledge governs the individual activities or how tacit knowledge may be put to use in the community. My work contributes to the field of KM research by proposing an interpretation that explains how tacit knowledge is activated, and how it may be made tangible. Since my work is focused on the usage of information technology (IT), I have studied how people interact with IT rather than the technology itself. To study whether agent-based retrieval systems could assist us in defining our true interests, I needed an intranet retrieval application prototype. Therefore I used a commercially available tool to implement the prototype, but the choice of tool was not significant for the research - any agent-based product would have worked.

In the next section I will describe the domain in which I performed our empirical study and explain my research methodology. I will then present the fundamental features of the recommender system prototype before reporting the results. In the last two sections I discuss the results and suggest more general interpretations and conclude with a summary.

2. Domain and Research Method

The empirical fieldwork took place at Volvo Information Technology, an IT service company within the Volvo Group. Volvos intranet consisted of some 450 web servers and had approximately 400,000 documents. Most of the content was official or semi-official information, such as department presentations, project reports, frequently-asked-questions (FAQ's), and online help material.

I invited approximately 80 users to participate in the study, which ran from August to November 1998. Most, but not all, of the 48 users who actually registered and participated in the test were Volvo IT employees and their job descriptions varied from technicians and system developers to content providers and administrators. All were experienced computer users. The users were invited to a 2-hour introduction meeting, where I explained the purpose of the research, the concept of agent-based systems, the design of the application and how to operate it, how to register and login, and how to set up and run individual agents. I also asked the participants to keep informal records of particular incidents that they considered worth noting, and informed them that I was going to contact them during or after the test to collect their viewpoints. The seven users that were unable to attend either of the three introduction meetings received the above information via email.

User experiences have been collected in several ways. All users were invited to a group interview but only eight showed up. The remaining users were then sent an email questionnaire, which again only some answered. After a first analysis, based on the so far received answers and the application log files, I conducted seven semi-structured qualitative interviews, each lasting between 28 and 66 minutes. This data was again analysed, using the grounded theorising approach suggested by [Hammersley & Atkinson 1995], where the body of data is used to generate concepts which in turn helps develop typologies and theories.

3. Choice of Tool and Design Decisions

Recommender systems are able to anticipate which items a user is likely to be interested in and can thus, in a hopefully intelligent way, recommend such items. How this "anticipating intelligence" is implemented varies from product to product and is not relevant to this paper. Academic research as well as the success of commercial products has shown that such systems do work and we may safely assume this to be true in this particular case. The aim of my research was not to develop and study new agent technology *per se*, but rather to examine *how* such a technology could be used in an innovative way. To speed up the development process I therefore wanted to build on existing software tools, if such were available. The product used in the research used neural networks and advanced pattern matching techniques to identify text patterns in profiles and look for similar patterns in other profiles or web documents. Each web document was synthesised into a 0.5K digital representation, a "fingerprint", and the characteristics that give the text meaning were determined. Once the fingerprint signature was created, the reasoning engine could perform concept matching (e.g. finding documents relevant to each other), agent creation (e.g. setting up agents that can find relevant documents), and agent retraining (e.g. adapt the agent to a set of relevant documents).

The prototype was designed and implemented to support the following features:

- Offer agents that could be set to find documents based on user profiles, e.g. a richer representation of an interest than just a keyword-based query.
- Provide mechanisms to enable retraining of the agents based on positive user feedback on retrieved documents.
- Enable users to locate colleagues with similar job descriptions or organisational roles by matching user profiles.
- Display users with similar interests by matching their agents.

Since each user was to be offered personalised agents they had to identify themselves by logging in. In addition to personal agents we also decided to offer *general agents*, i.e. publicly available agents pre-trained by us. [Figure 1a] depicts the log-in screen with the three general agents to the left and the private section to the right.

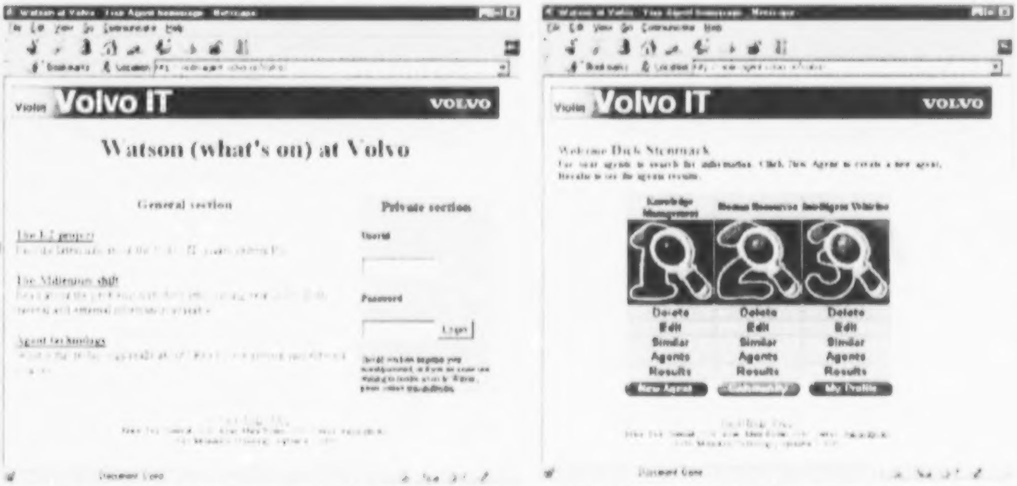

Figure 1: a) Watson's start page with the three general agents (the K2 project, the Millennium shift, and Agent technology) and the private login section. b) The individual agents available for inspection. The user may also create new agents, browse the community, or update the profile.

Once logged in, the users can create a *New Agent*, try to locate other employees with similar profile by invoking *Community*, or create/update their profiles by clicking *My profile*. When creating an agent the user gives the agent a name and assigns it a task. The task, equivalent to a search engine query, is not limited to keywords and Boolean connectives but may, and should, be expressed in natural language. In fact, the more text entered the better. The best result is achieved when the user cuts and pastes a large chunk of text from a relevant document and asks the agent to find more similar documents. After the agent is created, it is displayed on the screen. The example in [Figure 1b] shows a user with three agents: Knowledge Management, Human Resources, and Intelligent Vehicles. For each agent the user can delete it, edit it, find similar agents, or check the result. The number of individual agents was limited to five per user.

One of the first things a new user should do is to create a user profile. In the profile, the user can describe his or her professional interests in a free text fashion. If the user already has a CV stored elsewhere, it may be pasted

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into this field. The profile, once saved and stored, will be converted to a fingerprint and used when the Community function is invoked.

When clicking on *Community* or *Similar Agents* the user profile or the agent profile is matched with other users' or agents' profiles and the matching users are listed as seen in [Figure 2a]. The user may now display the email address or the profile of the found users (by clicking the *e-Mail* or *More info...* buttons, respectively) and can use this information to contact them.

The search results from the agents are displayed in a simple list, similar to those generated by most search engines [Fig. 2b]. However, when the user has verified that one of the returned documents is indeed relevant, the user can provide the agent with *positive feedback* by marking the document and clicking on the retrain button. The fingerprint of the agent will then be merged with the fingerprint of the selected document(s) and the result will become the new agent fingerprint, replacing the previous one.

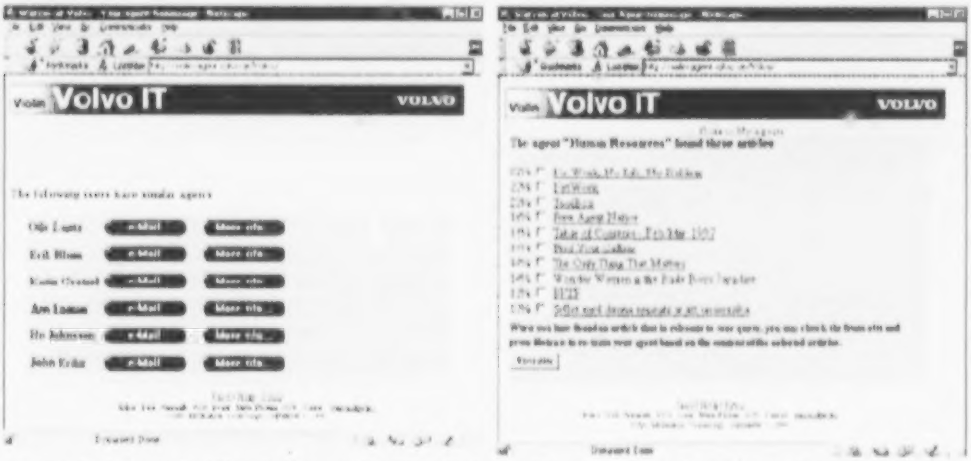

Figure 2: a) A click on the "Similar Agents" button displays a list of users who have created agents with similar profiles (i.e. users who have similar interests). b) The agent shows the 10 best matching results. By checking a document and clicking the retrain button, the agent can be re-trained.

4. Results

The users typically used the application frequently, sometimes heavily, during a couple of days and then stayed away from it for a while before returning for the next session. Usage was especially high right after the release of the application, and then declined slightly before settling on a stabile level throughout the rest of the test.

Overall, user reactions were very positive. The respondents said they believed in this technology and considered it to be "an extremely important asset" with a "great potential". The most frequently reported reasons for these beliefs were that it was "easier to construct queries" and that it "saved time not having to search". One user put it this way: "In the future we're gonna be bombarded with even more info and this may be the only way to stay ahead". More specifically, several users expressed their appreciation of not having to come up with descriptive keywords, since "*they never really contain the meaning you have in mind anyway*", to use the words of one respondent.

Despite the general claims that this sort of "unattended help" with information retrieval is welcomed and appreciated, the users actually mainly reported negative experiences. Many users report what they refer to as "strange" or "unexpected" results. "*[It is] hard to get something useful out of it. After retraining it with relevant documents it comes up with nothing*" as one user put it. However, the users tend to blame these bad results on their own inabilities. One user having received very little useful information says "*The rather shallow results may depend on me not using the right words. Otherwise I like the idea. Keep improving!*"

Our recommendation system prototype differed from how conventional Web search tools, such as search engines, are operated, and the users initially had problems adjusting. A common problem was that the users overtrained their agents. Some commented that they felt the way the agent worked had to be better understood by

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the users in order for them to be able to interpret and anticipate the outcome of the search. The users who attended the introduction all appreciated the information and claimed that it helped them to use the tool in a better way. The answers from the users *not* attending the initial kick-off also clearly indicate that training is required. One non-attending user said: "*It took some time before I understood [how to set up the agents] ... I think the instructions should be even clearer, so that you understand what the agent is and how it works*".

Not many of the test users exploited the Community feature, i.e. the feature that locates users with similar role description profiles. The reasons given for not using the function were that the test users already knew enough people doing similar jobs or that most users with similar profiles worked in the same department as the respondents. Alternatively, as one user put it, "*What's the use of hooking up with people doing the same stuff I do [...] It would probably be better to team up with those who know stuff I don't know.*" This last remark was an opinion shared by several users, who suggested that an opportunity to search for users with *complementary* profiles would have been more useful. Of those who actually did try the Community feature, all but one considered it to be working. One user, however, claimed to have been connected to people with whom he had nothing in common, and this he referred to as "*a bug*".

The Similar Agent feature was however much more frequently used though it was built on pretty much the same sort of knowledge as the Community feature. "*It's really interesting to see who else is searching for these sort of thing*", one of the users commented. Many respondents reported that they were surprised to find certain people sharing their interests, or that the Similar Agent feature returned users not expected to be interested in a particular topic. These comments were not expressed negatively. On the contrary, the users regarded this result as a useful new insight and no one questioned the correctness of the result.

5. Discussion

The users clearly preferred exemplifying their interests by pointing to relevant documents rather than having to invent clever keywords. This, I argue, is because the former involves tacit knowledge while the latter requires a translation to explicit knowledge. I further suggest that this distinction between tacit and explicit knowledge also explains the different ways in which the Community feature and the Similar Agents feature were used.

The Community feature, which is based on explicit knowledge, has not been used much at all. There are several possible reasons: Firstly, this research is carried out on a corporate intranet and not on the World Wide Web. The whole organisation may see itself as a community of which the users are already members, and the need to be associated with sub-communities may not be particularly strong. This I find not very likely. Secondly, conventional office tools, e.g. word processors or email programs, do not support a community concept and the users are thus not familiar with this way of working. They do not see themselves as community members, and do not appreciate the full potential of the concept. Tangible business benefits may first have to be experienced for this new way of working to be appreciated. This alternative seems more plausible than the first. However, none of these two are strong candidates.

The third and most feasible explanation is that the Community feature was built on static profiles provided by the users themselves to mirror the official responsibilities placed upon them by the organisation. These profiles are presumably already known to the members and experienced as fictitious, since people are often viewed as performing their jobs according to their formal job descriptions though everyday practice provides evidence of the opposite, as shown by [Brown 1998]. This is consistent with the findings of [Argyris & Schön 1974] who refer to the worldview and values that people believe their behaviour is based on as "espoused theory" as opposed to "theory-in-use". The users rightly or wrongly assume that they know what the Community feature will return and they dismiss it as uninteresting.

The "Find similar agents" feature is different from the above in that it does not rely on static profiles but on the dynamics of retrained agents, initially created for a totally different purpose. The prompt "Enter your profile" connotes an official question equivalent to "what is your profession?" and the user enters the supposed official answer that corresponds to his or her role description. The agents, on the other hand, are created for personal benefit only and no official considerations are taken into account. Instead, real professional interests govern the choice of topics, which makes these profiles more "alive" than the previous ones.

The most notable observations from the interviews are that when matching job profiles built on explicit knowledge and espoused theory of work, the user, being linked to unexpected colleagues, referred to the result as "strange" in a negative meaning. At the same time, the users matching agents built on tacit knowledge and practice commented similar results as "interesting" in a positive meaning. The tacit theory-in-use is obviously regarded as more trustworthy. Setting up and training personal agents create search profiles that are able to represent valuable tacit knowledge in a non-intrusive way. Since the primary objective for the agent is to find the user relevant information the incentive to create and maintain agents exists naturally, and the otherwise hard to overcome problem of having to set up profiles for somebody else's benefit is neatly avoided.

To be able to find this knowledge is, however, only a first step; it only helps to identify people within the organisation - it does not prevent these people from leaving the organisation nor guarantee that they will have time to share their knowledge on request. [Davenport & Prusak 1997, p.81] observe that "mapping who knows what in an organization creates an essential knowledge inventory, but does not guarantee the ongoing availability of knowledge". To achieve such permanent capturing and storing of knowledge, other measures that fall outside the scope of this paper must be deployed.

6. Summary

I have argued that agent-based retrieval system technology could act as a facilitator in the knowledge managing process of capturing tacit knowledge on an intra-organisational web. The are two main benefits of such an approach: i) the otherwise hard to solve problem of being able to produce an exhaustive definition of one's interests is replaced with the much simpler task of determining whether or not a given document is interesting, and ii) since a good profile results in more accurate information, a natural incentive to maintain the profile by giving feedback is created.

Previous research on agent-based retrieval system has studied how to connect users with information or users with other users. While this study shows that both these goals may be achieved simultaneously, it also introduces a third, and until now unnoticed, aspect of agent-based retrieval systems. My contribution to the field of KM research is the observation that profiles based on the tacit knowledge of practice are conveyed as more trustworthy than the espoused theory-based job description profiles. The former profiles can be used to facilitate the sharing of tacit knowledge without having to make knowledge explicit.

7. References

Argyris, C., & Schön, D. (1974). *Theory in practice: Increasing professional effectiveness.* San Francisco, CA: Jossey Bass.

Brown, J. S. (1998). Internet technology in support of the concept of "communities-of-practice": the case of Xerox. *Accounting, Management and Information Technologies*, no. 8, pp. 227-236.

Davenport, T. H. & Prusak, L. (1997). *Working Knowledge: How Organizations Manage What They Know.* Boston, MA: Harvard Business School Press.

Fagrell, H. & Ljungstrand, P. (1998). Make an Agent and you shall find: An Intranet Recommender System. In Buch et al. (Eds.), Proceedings of IRIS21, Department of Computer Science. Denmark: Aalborg University.

Grudin, J. (1987). Social Evaluation of the User Interface: Who does the Work and Who gets the Benefit? In Bullinger, H.-J. & Shackel, B. (Eds.), Proceedings of INTERACT '87. North-Holland: Elsevier Science Publishers.

Hammersley, M. & Atkinson, P. (1995). *Ethnography: Principles in practice* (second edition), London and New York: Routledge.

Polanyi, M. (1966). *The Tacit Dimension.* London: Routledge and Kegan Paul.

Polanyi, M. (1998). The Tacit Dimension. In Prusak, L. (Ed.) *Knowledge in Organization.* Boston, MA: Butterworth-Heinemann.

Resnick, P. & Varian, H. R. (Eds.) (1997). Recommender System. *Communications of the ACM*, vol. 40, no. 3, (entire issue).

SMILE Maker: A Web-Based Tool for Problem Solving

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Abstract: This paper focuses on the purposes, theoretical model and functionality of the SMILE Maker - a web-based problem-solving tool. From instructional design point of view, an attempt to established a balance between constructivism/ instructivism, content-treatment interaction/aptitude-treatment interaction, and user locus of control/system locus of control has been made. The model behind the SMILE Maker consists of four sub-models: user, content, instructional events and facilitator as each of them is being built up from four components. A new concept mapping method has been developed and experimentally validated. Four instructional scenarios are being discussed.

Introduction

The SMILE Maker is aimed at assisting people in perceiving, analysing and organising information when ill-structured problems occurs. SMILE stands for Solution Mapping Intelligent Learning Environment. SMILE Maker as a problem-solving tool is a synergy between mapping approaches and creative problem solving techniques. As a learning tool the attention has been paid on optimising the way users learn how to use this tool. From a functional perspective SMILE Maker implies a multi-agent approach to provide intelligent and efficient system-user interaction. The current version of SMILE Maker implemented in Java is a portable and platform independent tool.

In this paper concept mapping has been mentioned in two aspect: as a problem solving technique and as an ontological formalism describing the behaviour of an intelligent agent-based facilitator. Concept mapping is being considered also as a generic term standing for all mapping approaches - classical concept mapping, mind mapping, cognitive mapping, flowscaping, etc. Concept mapping has been defined as a knowledge representation graphical technique that uses a very simple conventional means of nodes, links and labels on the links to explore a problem solving space. However, knowledge representation is rather narrow predicate to express these phenomena. Concept mapping might be defined as a cognitive, affective, meta-cognitive, synergetic, and problem solving tool [Stoyanov 1999]. These functions of concept mapping are complementary to each other, as problem solving is the most subsuming category. The effectiveness of concept mapping as a problem-solving tool depends on the effectiveness of concept mapping as cognitive, an affective, a meta-cognitive, and as a synergetic tool.

Concept mapping is a *cognitive* and *affective* tool. Concept mapping is one of very few if not single graphical techniques that represents the way human mind organises information in problem solving. Moreover, concept mapping is an external extension of the cognitive and affective structures of personality. It enlarges, for example, the natural limited capacity of working memory. That reduces cognitive overload, improves the quality of problem solving production and enhances the speed of the ideational processes.

Concept Mapping is a *meta-cognitive* tool. It externalises cognitive processes and structures when problem solving occurs. Concept mapping stimulates self-appraisal (self-reflection), and self-management (control and monitoring), giving a sense of distance and ownership.

Concept mapping is a *synergetic* tool. It enables all psychological processes (attention, perception, memory, thinking, and language) to be involved (*process synergetic*). Attention directs perception, perception frees up memory, and memory makes reasoning processes more easy and flexible. Concept mapping integrates two kinds of coding - verbal and visual (*code synergetic*). The technique capitalises on the advantages of graphical representations without losing the flexibility and the power of natural language system. Concept mapping provides a whole picture of problem solving space and shows the relationships between components (*product synergetic*).

Concept mapping is a *problem-solving* tool. It is not only information representation technique (*information collection tool*), but it is also idea generation (*divergence tool*) idea selection (*convergence tool*) and idea implementation technique (*planning tool*). Concept mapping communicates very well with creative problem solving techniques and supports the generation of unusual problem solutions (*lateral tool*).

Most of the mapping approaches are founded on a particular theory. Classical concept mapping approach is based on assimilation theory [Aussubel 1978; Novak & Gowin 1984]. Mind mapping [Buzan 1996] is associated with radial thinking theory. Flowscaping is grounded on the lateral thinking theory [De Bono 1994], and cognitive mapping interprets the Kelly's personal construct theory [Kelly 1955; Eden et al. 1995].

Some special software applications for concept mapping have been made available in order to improve the effectiveness and efficiency of concept mapping technique in a problem solving. Thus, Decision Explorer software supports cognitive mapping, MindMan uses mind mapping strategy, Inspiration is appropriate for applying the classical concept mapping conventions in problem solving

SMILE Maker differs essentially from above mentioned otherwise very attractive tools in two points:

- SMILE Maker is web-based tool.
- SMILE Maker supports the synergy between problem solving and learning.
- SMILE Maker uses an agent-based approach in order to realise a user-friendly and efficient human-system interaction.

SMILE Maker Rational

There are some theoretical trends SMILE Maker is based upon:

- SMILE Maker is both an individual and a group tool. There is a special component, called 'Partner' where all group activities are accumulated.
- SMILE Maker is both a content-treatment interaction and an aptitude treatment interaction tool. The tool proposes a new concept mapping method as a content to be acquired. It is also sensitive to the individual preferences in learning and problem solving.
- SMILE Maker is both external and internal locus of control tool. At the one extreme of this continuum are people that prefer to be guided (external locus of control) and at the other pole are persons who want to construct their own learning environment (internal locus of control).
- SMILE Maker is designed on the basis of the 4-AID generic agent-based model [Kommers, Aroyo, & Stoyanov 1999]. It consists of *four* sub-models: content, instructional events, user and intelligent agent-based facilitator.

Content sub-model is about a new concept mapping method. It includes *four* units: map information collection, map idea generation, map idea selection, and map idea implementation. Each map can be identified by purpose and particular components, supported by some specific creative problem solving techniques.

Map information collection is purposed to assemble all available information in problem space. The problem solving environment is explored in the terms of scientific facts, statistical data, personal experience, assumptions, metaphors and analogies, feelings, etc. Map idea generation is aimed at generating as many problem solutions as possible. With the map idea generation problem solving space is explored in the terms of ready-made solutions, suggestions, elaboration, unusual or "crazy ideas". Map idea selection purposely has to find the best candidate among the alternatives. The objective of map idea implementation is to operationalise a problem solution in the terms of sequence of activities and events, to present the needed steps in order to put solutions into practice.

Learner sub-model is defined by *four* learning styles: activist, reflector, theorist and pragmatist [Honey & Mumford 1992]. The large-scale complexity of the instructional strategies might be reduced to a representative sample of *four* instructional events: explanation, example, procedure, and practice. Each learning style manifests the subject's preferences to one of the instructional events. Theorist is very likely to choose an explanation. Reflector should look for an example. Pragmatic should start with procedure, and activist should go directly to the practice.

Agent-Based Support Layer

The Facilitator - an agent-based component, provides flexible and user-oriented assistance to the user in learning and problem solving. Many different roles are delegated to a number of agents, which in combination produce the behaviour of the facilitator as a user instructional designer, user navigator, system processes co-ordinator and adaptive content provider.

From a methodological point of view, the behaviour of the facilitator is premised upon the assumption that everybody has a potential to be complex and flexible in problem solving. From an ontological point of view, the behaviour of facilitator is formalised as a master concept map containing all components of content and instructional events in declarative knowledge format. This way the complexity in reasoning and extensive knowledge processing is simplified to reactive agent behaviour based on concept mapping formalism [Aroyo & Dicheva 1998]. A particular combination of Content units and Instructional Events constitutes a user's map. The facilitator identifies the gaps between the master map and a user's map and reacts according to specific production rules. One of the most important principles is that the cycle of Content units and the cycle of Instructional Events have to be completed. Thus, the facilitator creates more versatile problem solving style capitalising on the strong points of a particular style and minimising its weak points.

From a functional point of view the facilitator works on the basis of multi-agent layer within the architecture of the SMILE Maker tool. The multi-agent paradigm provides means to characterise processes, which occur in different modules of the system that is responsible for their performance. It creates an advantage for the facilitator - system instructional designer - to act as a reasoning and knowledge-based component not explicitly presented at the user interface. The users get only the result of its decision processes.

The modelling and the design of the facilitator layer is based on compositional development method for multi-agents systems called DESIRE and implemented in the AI department of Vrije Universiteit, Amsterdam. DESIRE stands for DEsign and Specification of Interacting REasoning components [Brazier, Jonker, Treur 1999]. This way both external and internal agent functionality are explicitly defined. The internal agent functionality concerns the expertise (knowledge requirements and reasoning capabilities) for performing domain tasks for which the agent is responsible. The external agent functionality concerns the social abilities in terms of co-ordination, guidance, co-operation and other forms of social behaviour.

In Figure 1 processes and architecture components are presented within the framework of the multi-agent support layer. Result of their activities is presented as behaviour of the system facilitator within the four scenarios described. It is a generic architecture, which supports process interaction and co-ordination in the frame of a user request and the adaptable system support provision described above. Some details and examples of facilitator's behaviour are also added later in the paper.

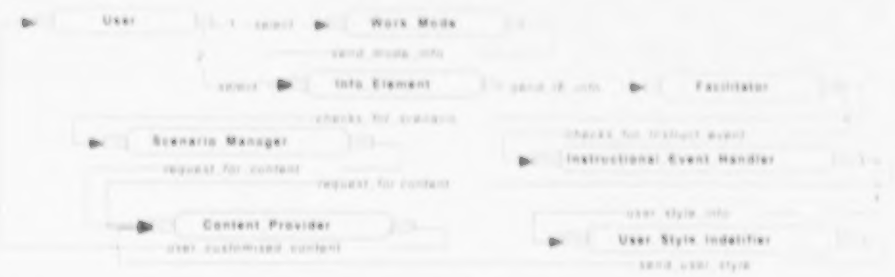

Figure 1: Compositional design of multi-agent support layer.

New Concept Mapping Method Validation

Two steps were undertaken in order to validate the new concept mapping method and to make it legitimate for the SMILE Maker. At first, a new concept mapping method was proposed as a tutorial in the framework of Ed-Media & Telecom conference [Kommers & Stoyanov 1998] and as a workshop during the conference Information Technologies and Programming [Kommers & Stoyanov 1998]. The purpose was to catch

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the strong and the weak points of the methodology and to take a general impression of how the people perceive the method. The audience attended these events expressed positive attitudes to the method.

Secondly, an experiment was conducted to get more strong evidence supporting the assumption that the new concept mapping method is an effective and efficient tool for problem solving [Stoyanov 1999]. The experimental design was factorial including as first independent variable concept mapping method with two levels: the traditional and the new one. The second independent variable was learning styles with two levels - doers and thinkers. The dependent variable was concept mapping production. 32 students from Faculty of Mathematics and Computer Science at University of Sofia were randomly selected and then randomly assigned to the experimental and the control groups according to their learning styles. The experimental group was trained in the new concept mapping method, and the control group was treated in the traditional method. Then the subjects were asked to solve a case.

The new concept mapping method proved to be more effective from the classical one as a significant difference was found on the main criteria such as broad perception, divergence, convergence and planning.

SMILE Maker Functionality Description

At the top level, SMILE Maker presents several functional components available for the user: Introduction, Guide, Resources and Scenarios. 'Introduction' provides with general information what the SMILE Maker tool is about. 'Guide' gives hints as how to navigate in the site. Apart from this general remarks each page has navigational tips with more specific information. 'Resources' contains opportunities to select some available concept mapping software for problem solving, to choose some creative problem solving techniques, to see some templates taken from a broad scope of subject domains, and to make a search in a gallery of stored maps. Although these variables are very important, in this paper we will focus on the 'Scenarios' component. A special attention will be paid also to the group work mode called 'Partner'.

Learning Scenarios

There are four types of scenarios: Ready-made, Tailor-made, Self-made, and Atelier. 'Content' and 'Instructional Events' are parts of each scenario but they are treated in a different way.

Ready-made Scenario

Ready-made scenario is purposed for the people who like to be guided. The 'Content' units are considered in predetermined order starting with 'Map information collection' and finishing with 'Map idea implementation'. The order of 'Instructional Events' is also fixed. 'Explanation' is the first and 'Practice' is the last one. A user might start with map information collection and than each page is associated with particular instructional events. When a user enters the 'Practice' a graphical editor is opened automatically and he/she could apply what has been learned.

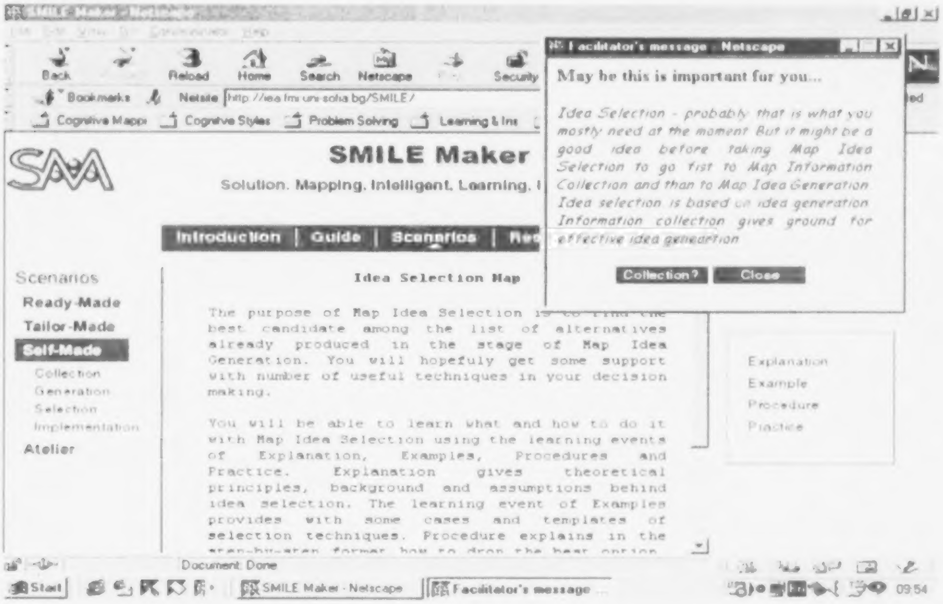
Tailor-made Scenario

'Tailor-made' scenario is challenged to provide an instruction according to the learning preferences. The locus of control is still on the system in respect to content providing, but it gives more freedom for an instructional event selection. This scenario is designed for the users that prefer to be leaded but the instructional path is predefined according to their learning preferences. Thus, a user gets the opportunity to identify him/herself as one of learning style and than follows a specific pattern. The patterns are 'Explanation', 'Example', 'Procedure' and 'Practice'. The source of variation is only 'Instructional Events'. The four user types are included as a common knowledge of the multi-agent system and this provides facilitator with the reactivity to the initial user's selection of an instructional event.

What makes differences from the first scenario in respect to 'Instructional Events' is that each path (pattern) is self-contained. It is dominated by one of the instructional events, but also includes pieces from other instructional events. For instance, the 'Explanation' pattern includes some 'Examples' and gives some 'Procedures' before suggesting the 'Practice'.

Self-made Scenario

The sources of variation in the 'Self-made ' scenario are both 'Content' and 'Instructional Events'. There is not predefined sequence of problem solving maps. However, the content is still SMILE concept mapping method. The user can start picking up any of the maps and then select any of the instructional events. The assumption is that the user selects a specific option because of need to perform specific actions. When a user chooses 'Map idea selection' simultaneously with an introduction to this kind of map, a pop-up message from the facilitator appears on the screen providing with some advises. The facilitator reacts also when a user skips some of the 'Instructional Events' and goes directly to the 'Practice'.


SMILE Maker - Netscape
Back
Reload
Home
Search
Netscape
Security
Bookmarks
Netsite http://iea.fmi.uni-sofia.bg/SMILE/
Cognitive Mappi
Cognitive Styles
Problem Solving
Learning & Ins
SMILE Maker
Solution. Mapping. Intelligent. Learning. I
Introduction | Guide | Scenarios | Re
Scenarios
Ready-Made
Tailor-Made
Self-Made
Collection
Generation
Selection
Implementation
Atelier
Explanation
Example
Procedure
Practice
Document: Done
Start
SMILE Maker - Netscape
Facilitator's message
09:54
Facilitator's message - Netscape
Collection?
Close

May be this is important for you...

Idea Selection - probably that is what you mostly need at the moment But it might be a good idea before taking Map Idea Selection to go fist to Map Information Collection and than to Map Idea Generation. Idea selection is based on idea generation Information collection gives ground for effective idea generation

Idea Selection Map

The purpose of Map Idea Selection is to find the best candidate among the list of alternatives already produced in the stage of Map Idea Generation. You will hopefuly get some support with number of useful techniques in your decision making.

You will be able to learn what and how to do it with Map Idea Selection using the learning events of Explanation, Examples, Procedures and Practice. Explanation gives theoretical principles, background and assumptions behind idea selection. The learning event of Examples provides with some cases and templates of selection techniques. Procedure explains in the

Figure 2: Screen-shot of self-made scenario

Atelier Scenario

'Atelier ' scenario is presupposed to serve for people who are self-confident in building up an own concept mapping approach. There are several components which a user could select from: Ideas, Maps, Templates, Method, and Practice. 'Ideas' stands for creative problem solving techniques. 'Maps' presents some mapping approaches like concept mapping, cognitive mapping, mind mapping, and flowscaping. 'Templates' presents some examples of combinations between mapping approaches and problem solving techniques. 'Practice' provides a graphical editor for maps drawing. 'Method' proposes the new concept mapping approach with four problem solving maps to be drawn. If a user selects this scenario and then goes to the practice, the facilitator reacts with a suggestion to her or him to have a look at other options such as Ideas, Maps and Templates in order to construct more effective strategy.

Group-work Mode - 'Partner'

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There are three different sub-modes of collaborative work in the 'Partner': exchanging of individually produced maps (Pin Sub-Mode), creating a common map within shared workspace (Brainstorming Sub-Mode) and moderating the group consensus through collecting, creating and sharing maps (Delphi Sub-Mode). With the first sub-mode, users take benefits getting some insights when looking at others' maps. The second sub-mode is an on-line collaborative work. A group solves a problem, making a common map(s) on the shared workspace. The SMILE Maker facilitates the group composition, interaction and work regulations. Different group problem solving techniques are available as well. With the third sub-mode a group member or the tutor could take the role of moderator. Individuals or small groups produce their concept maps solutions of a problem and than send them to the moderator. The moderator draws an adjusted map containing the main features of the individually produced maps. Then she/he sends it back to the group members that initiate a new stage of problem solution until a consensus is reached.

There are three main options available in 'Partner'. "Send a map" automatically opens e-mail box for sending individually produced map or a sequence of maps to another user, or to the moderator. "Gallery" gives an access to a pool of concept maps, created by other users, sorted by content (topic) or the type of map. The process of problem solving and the final map products are visible. SMILE Maker provides the option of saving several steps of maps' production and presenting them as a sequence on user request. When user initiates a problem solving, she/he could use "Gallery" to search for similar problems and models of solutions.

"Shared workspace" offers several options: group composition, techniques, rules, communication, and history. 'Group composition' gives some hints on the group size and homogeneity/heterogeneity in the terms of level of expertise, personal style and professional status. 'Techniques' provides information about group creative problem solving techniques. 'Rules' are about conventions of participation, self-presentation, timing, steps and procedures in creative problem solving techniques, some restrictions as well. 'Communication' supports a user to specify topic, objectives, rules, and techniques, to use some facilities such as a chat and to make an evaluation. 'History' saves not only the final concept mapping production but also the steps in creating a map(s).

"Shared Workspace" is based on Java Shared Object metaphor. Each common or shared map is composed of several linked-shared objects. A master copy of such a map is stored on the central server and this copy is replicated to all clients in a single collaborative session. When the user makes some changes in the nodes, links and labels within a common map these changes become immediately visible to all users.

References

1. Aroyo, L. & Dicheva, D. (1998). Agents that Make Your Information Meaningful and Visible: An Agent-Based Visual Information Management System, *Proc. of the WebNet'98 Conference*, AACE, Orlando, USA.
2. Aussubel, D., J. Novak, & H. Hanesian (1978). *Educational Psychology*. A Cognitive View. N.Y: Holt, Rinehart and Winston.
3. Brazier, F., Jonker, C., Treur, J. & Wijngaards, N.J.E. (1998). Compositional design of a Generic Design Agent. In: G. Luger, L. Interrante (eds.), *Proc. of the AAAI Workshop on Artificial Intelligence and Manufacturing: State of the Art and State of the Practice*, AAAI Press.
4. Buzan, T. (1996) *The Mind Map*. Book. N.Y: Plume.
5. De Bono, E. (1994) *Water Logic*, London: Penguin Books.
6. Eden, C.L., F. Ackerman & Cropper (1995). *Getting Started with Cognitive Mapping*. Supplied with Graphics COPE v2. Banxia Software, Glasgow.
7. Honey, P. & A. Mumford. (1992). *The Manual of Learning Styles*.
8. Kelly, G. (1955) *The Psychology of Personal Constructs*. New York: Norton.
9. Kommers, P., Aroyo, L. & Stoyanov, S. (1999). Agent-Based Instructional Design Model for Cognitive Mapping. *Proc. of the Ed-Media and Telecom'99 conference*, AACE, Seattle, USA, 482 - 488.
10. Kommers, P. & S. Stoyanov (1998) Concept Mapping: practical implications in meaningful context - a tutorial. *Ed-Media & Telecom'98 conference*, Freiburg, June 20-25.
11. Kommers, P. & S. Stoyanov (1998) Computer-Based Concept Mapping in Problem Solving Design - a workshop. *IT & P' 98 (Information Technology and Programming '98) conference*, Sofia, June 9-13.
12. Novak, J. D. Govin. (1984) *Learning How to Learn*. Cambridge: Cambridge University Press.
13. Stoyanov, S. (1997) Cognitive Mapping as a Learning Method in Hypermedia Design. *Journal of Interactive Learning Research*, vol. 8, No 3/4, 309 - 325.
14. Stoyanov, S. (1999). *Cognitive Mapping as a Learning Method in a Problem Solving Design*. Interim Report. Faculty of Educational Science and Technology, Department of Instrumentation, University of Twente.

Extending and interacting with the ITC system

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Abstract: The paper presents various enhancements to the ITC system, a system for defining the structure of Thematic Catalogs, populating them with information items and providing access to end-users, such as navigation and searching through its categories. The system has been extended, so as to provide multiple presentation formats of its categories and multiple ways for inputting data. Additionally, the system can now be used as a simple Web authoring system. Finally, some examples of the system's use are presented.

1. Introduction

The ITC (Interactive Thematic Catalog) system [Styliaras 1998] is an automated tool, which can be used for constructing Thematic Catalogs. The system helps in defining the structure of the catalog, populating it with information items and offering some basic services to end-users. These services include browsing and searching through the catalog's categories, viewing the content in multiple languages and contributing new information items to the system. From a structural point of view, in every ITC system, there are some basic categories that act as roots of the various categorizations. Every basic category is analyzed through a hierarchical tree of subcategories. In some of these subcategories near the bottom of the tree structure, information items can be classified. In most cases, an information item is just a hyperlink to a Web site page. A database is used for storing both the catalog's structure and the associations of information items to the catalog's categories.

In this paper, we will present some enhancements added to the basic features of the system, concerning both the internal structure of the system and the services provided and affecting both content providers and end-users, who simply browse and search the system's contents. These enhancements, which will be analyzed in the following sections, have been inspired by the use of the system in various applications, as it will be discussed in Section 7. Each of these applications provided us with valuable requirements regarding the way information should be defined, related, accessed and manipulated by different categories of users such as end-users, specialized content providers and technical users The major enhancements include allowing multiple representations of some categories' contents and implementing multiple ways for data input according to both the experience of the content provider and the characteristics of the data. Finally, the ITC system provided an excellent testbed for experimenting with different technologies, such as Java / Swing (4.1), Dynamic HTML (3.1), XML (4.2) and Visual Basic (system core), and understanding how these technologies can inter-operate. In every case, we examine each technology's strengths and weaknesses and we manage to integrate these technologies into a single system.

2. Changes in the structure of the ITC system

Taking into account the application of ITC into some real-life projects analyzed in Section 7, we have concluded that it was necessary to enrich the internal structure of the system, which is the underlying database, by allowing two main extensions. Firstly, it is now possible for an information item to have more than one classifications according to a certain basic category. For example, assume a time-based categorization that is analyzed in small, independent chronological periods. An information item spanning more than one periods will have multiple classifications in this basic category. This enhancement gives the opportunity to the content provider to classify more precisely and accurately the information items according to the various categorizations. The second main enhancement deals with the main role of ITC in a Web site. Typically, an ITC system, as every Thematic Catalog, is used for classifying a set of pre-written HTML pages in a set of categories. Apart from this capability, ITC can act as a simple authoring environment, allowing the content provider to be able to compose the main content of the information item, during the association of the items to different categories. In this way, the content of the information items, the catalog's structure and the association of items to categories are all stored in the system's database. Additionally, all this content is automatically generated by the system, which enhances its portability. This enhancement has been embedded in ISTOPOLIS [Papaterpos 1999], a network-based educational system.

3. Multiple representations of the categories contents

Most Thematic Catalogs use a text-only representation of their content. Sometimes, if the context of the categories permits to do so, it is possible to provide alternative representations of these categories' content. In this way, end-users are offered a more efficient way to perceive the relationships among the different categories and information items. It is obvious that, as yet, this is a process that cannot be fully automated and an expert developer is required to embed the alternative representations in the system. Examples include basic categories analyzing geographical regions, chronological or scientific data. In the first case, maps may be used for displaying information items upon them, filtered by the classification of the items according to the rest of the basic categories. Concerning chronological categories, a time-based navigation tool may be defined for locating chronological events. In this way, multiple presentation formats are allowed according to the context of the basic category.

3.1 Geographic Tool

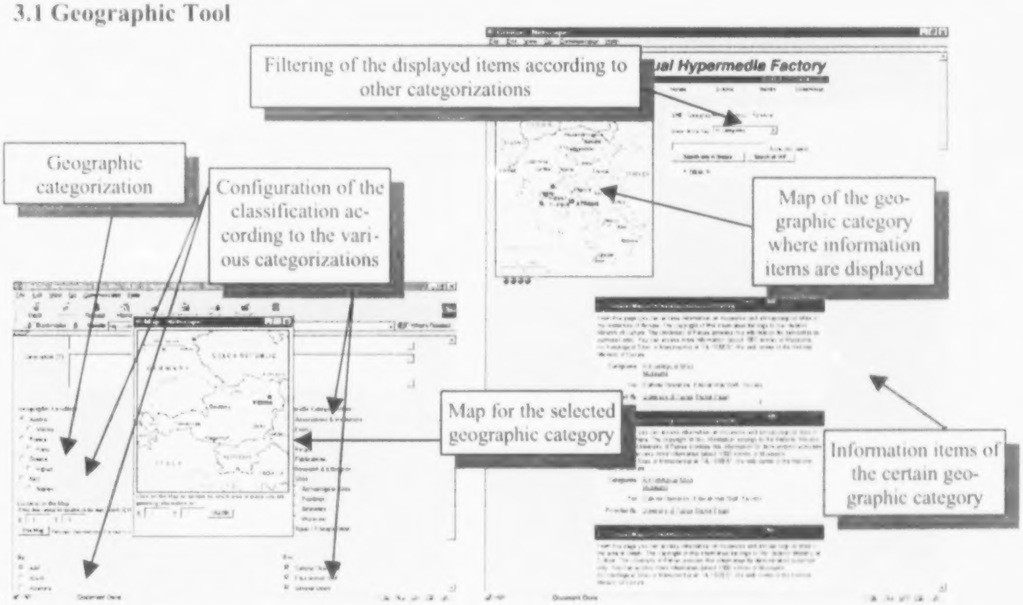
Filtering of the displayed items according to other categorizations
ual Hypermedia Factory
Geographic categorization
Configuration of the classification according to the various categorizations
Map of the geographic category where information items are displayed
Map for the selected geographic category
Information items of the certain geographic category

Figure 1: Map-based navigation subsystem

As an application of the previous idea, we have implemented an interface for map-based categorizations and embedded it in ITC. This geographical tool affects both the data-entry and navigation processes. During the definition of the geographic categories, which are usually geographic areas, the content provider has to supply a map for every area and enter its URL, allowing him/her so to use the map of his/her preference for a certain area. Additionally, as the subcategories of a geographic category are usually sub-areas that can be located on the category's map, the content provider should enter the coordinates for these sub-areas. In this way, it is possible to define hot spots over the maps and navigate, therefore, through the different levels of the geographic categories by using only their respective maps. This information is stored in the system's database, along with the rest of the data concerning the categories. During the population of ITC with information items, the content provider should supply, apart from the usual data (title, description and classification), the coordinates of the information items on the appropriate maps, provided there is classification according to geographic categories. This information is used for enhancing the navigation, by using hot spots on maps.

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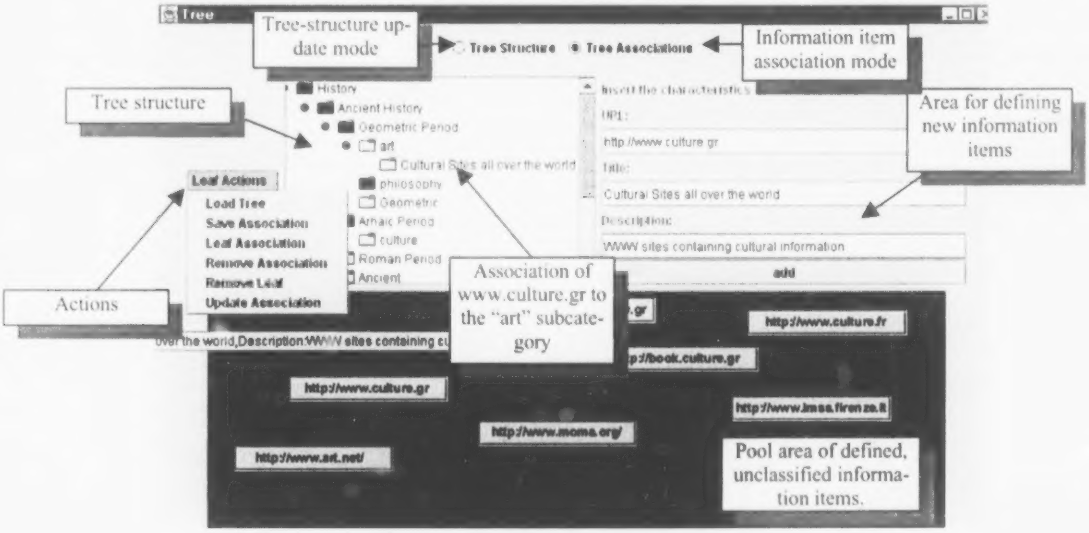
We have used a rather simple approach for implementing the map-based navigation in the ITC system. More specifically, the interface is built using Dynamic HTML and layers, which are supported by both commercial browsers. Prior to the appearance of Dynamic HTML, this kind of interface could be implemented using either server-side scripting for implementing the hot-spot capability on the images of the maps or Java. We have found out that both these options have drawbacks such as overload of the server, or speed. With the use of Dynamic HTML, we define one clickable layer for every information item or subcategory that is located on a geographic category map. There are many systems that implement similar map-based navigation techniques, such as the one described in [Orendorf 1996], but we have implemented a quite simple subsystem in order to test how easy is to integrate alternative presentation formats in ITC. The geographic subsystem has been embedded in VHF's [VHF] Web site, which is described in Section 7. In Figure 1, we can see two instances of the subsystem. On the left, the content provider can configure the coordinates of an information item by simply clicking on a map or providing the exact coordinates. On the right, the map is embedded in the generated page of a geographic category.

4. Various input types according to the level of the users

4.1 Graphical definition of categories and associations

As described in [Styliaras 1998], a simple HTML interface has been initially used for analyzing every basic category into subcategories. This process is convenient if a basic category is analyzed through a low-depth, rarely changeable tree of few subcategories. Otherwise, a more sophisticated tool is needed for configuring and updating, later, the categorization of information items. We have implemented a graphical tool for defining the categorization of the catalog and the classification of information items according to the defined categories. A hierarchical-like menu is defined that the content provider can use for defining the tree's basic and intermediate categories. Then a pool area is used where the content provider can drop newly defined information items by providing a title and description. Finally, in order to classify information items to categories, a similar interface is used, where categories appear in read-only mode and a special notation is used for recognizing in which categories it is prohibited to assign information items (e.g. red nodes in the above figure). The interface has been implemented using Swing's [Java] JTree graphical component.



Insert the characteristics

URL:

http://www.culture.gr

Title:

Cultural Sites all over the world

Description:

WWW sites containing cultural information

over the world,Description:WWW sites containing cu

Tree
Tree-structure update mode
○ Tree Structure
● Tree Associations
Information item association mode
Tree structure
History
Ancient History
Geometric Period
art
Cultural Sites all over the world
philosophy
Geometric
Arhaic Period
culture
Roman Period
Ancient
Area for defining new information items
add
Leaf Actions
Load Tree
Save Association
Leaf Association
Remove Association
Remove Leaf
Update Association
Actions
Association of www.culture.gr to the "art" subcategory
.gr
http://www.culture.fr
p://book.culture.gr
http://www.culture.gr
http://www.imss.firenze.it
http://www.moma.org/
http://www.art.net/
Pool area of defined, unclassified information items.

Figure 2: Data input process using JTree

4.2 Batch input of categories and associations using XML

When a basic category is analyzed in a large number of subcategories, it is tedious for an experienced user to de-

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fine the structure of a basic category by entering one subcategory at a time. Therefore, there is need for an automated tool to be offered to content providers in order to define the structure of the basic categories. Instead of defining a special notation language, we have decided to use XML [XML], which is suitable when defining a hierarchical structure of data elements. It allows an experienced user to define a simple XML file with the categories that will be included. This file is parsed by an automated tool and generates the appropriate category's definition table in the system's database. We have used the XML object shipping with Internet Explorer 5 for implementing experimentally this capability. The XML elements have attributes, defining the type of the category. For example, to define the category structure shown in Figure 2, the following XML file should be used:

```
<basic>
   History
   <category type="intermediate">
      Ancient History
      <category type="intermediate">
        Geometric Period
        <category type="intermediate">
          Art
        </category>
        <category type="final">
          Philosophy
        </category>
        <category type="intermediate">
          Geometric Antiquities
        </category>
      </category>
      <category type="intermediate">
        Archaic Period
        <category type="intermediate">
          culture
        </category>
      </category>
      <category type="final">
        Roman Period
      </category>
      <category type="final">
        Ancient Antiquities
      </category>
   </category>
</basic>
```

Figure 3: An XML file defining the structure of a category

The above extra features embedded in the ITC system illustrate clearly that no single kind of user-interface is suitable for every user and kind of data. On the opposite, multiple formats of varying difficulty should be provided in order for the content provider to be able to insert the data more efficiently.

5. User-defined templates for displaying leaves and categories

The ITC system has a pre-built template for building the interface of both the categories and leaves' pages. This process is not flexible enough if someone wants to use ITC in a site where all the pages have to comply with a certain look-and-feel. Therefore, data providers should have the ability to customize the appearance of ITC's pages according to their needs. Until now, an expert developer had to change and recompile the pages' generating code in order to change the default appearance of the pages. As we wanted to allow a more flexible use of ITC, even by non-programmers, we have defined a simple template-based notation, which can be used for configuring the appearance of ITC's pages. Our approach uses some special markup tags embedded in HTML, which are preprocessed in order to generate ITC's pages. Under this view, our approach resembles that of the special markup languages (such as ASML [Owen 1997], CFML [CFML], VBScript [VBScript]) used in some popular research and commercial web authoring systems. In our case, though, we enable the user to change only some specific properties, as the actual content of the pages is automatically generated. This fact helped us to determine a wizard-like sequence of steps that will guide the content provider to customize the appearance of ITC's pages. A typical ITC page consists of four main parts: the *header*, the section where *categories* are displayed, the *information items'* section and the *footer*. Apart from these sections some global parameters may be configured by the data provider and applied to all pages in which they are included in the form of a style sheet. Consequently, five steps are needed for determining the appearance of a typical ITC page, which are now shown in

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any of these steps is omitted, then a default way for displaying data is used instead.

Step 1: Global parameters. A background color or image may be configured, as well as the font style.

Step 2: Header. The content provider may configure every item of the header, such as the path from the root of the catalog until the current category, a logo image and a small introductory text. Concerning the path, a simple markup sentence may be used: `<H1>[[Root]]</H1> :{{<H1>[[Category]]</H1> :}}*`. In this sentence `[[Root]]` corresponds to the root of basic category, `[[Category]]` corresponds to a subcategory, and the enclosure into `{{...}}*` means repetition for every category.

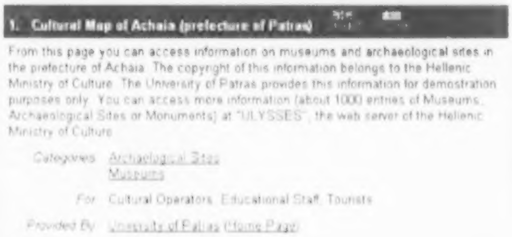
Step 3: Categories. The categories' section displays the links and names of the current category's subcategories along with a number indicating how many information items exist in a certain subcategory. A formatting sentence that can be used in this case is: `<UL>{{<LI>[[Category]] ([[Number]])}}*</UL>`. This sentence will generate the standard bulleted look-and-feel appearance of the categories as found in some popular Thematic Catalogs. In this sentence `[[Number]]` corresponds to the number of items in `[[Category]]`.

Step 4: Information items. The content provider may configure the way the title and description are displayed, as well as the labels and links to the rest of the categorizations.

Step 5: Footer. This step is similar to the header and enables the configuration of a finishing text and / or image.

As an example in Step 4, the following notation on the left corresponds to the appearance of the information item on the right. In this case, there are three basic categorizations: General thematic categories (Thematic), Users that may be interested in the information item (Users), Providers of the information (Providers).

```
<TABLE CELLPADDING=5 COLSPAN=2 WIDTH=507>
<TR BGCOLOR=#000052>
<TD VALIGN=TOP COLSPAN=2 WIDTH=100%>
<FONT FACE=Arial COLOR=#FFE8B4>
<SMALL><B>[[Number]].&nbsp;&nbsp;[[Title]]</B>
</SMALL>&nbsp;&nbsp;[[URL]]</FONT></TD></TR>
<TR BGCOLOR=#FFE8B4><TD COLSPAN=2><SMALL>
<FONT FACE=Arial>[[Description]]</FONT></SMALL></TD>
<TR BGCOLOR=#FFE8B4>
<TD ALIGN=RIGHT VALIGN=TOP WIDTH=20%><SMALL><I>
<FONT FACE=Arial>Categories:</FONT></I></SMALL></TD>
<TD VALIGN=TOP WIDTH=80%><SMALL><FONT FACE=Arial>
{{[[Thematic]]<BR>}}*</FONT></SMALL></TD></TR>
<TR BGCOLOR=#FFE8B4>
<TD ALIGN=RIGHT VALIGN=TOP WIDTH=20%><SMALL><I>
<FONT FACE=Arial>For:</FONT></I></SMALL></TD>
<TD VALIGN=TOP WIDTH=80%><SMALL><FONT FACE=Arial>
{{[[Users]], }}*</FONT></SMALL></TD></TR>
<TR BGCOLOR=#FFE8B4>
<TD ALIGN=RIGHT VALIGN=TOP WIDTH=20%><SMALL><I>
<FONT FACE=Arial>Provided By:</FONT></I></SMALL></TD>
<TD VALIGN=TOP WIDTH="80%"><SMALL><FONT FACE="Arial">
{{[[Providers]] ([[Providers.HomePage]])<BR>}}*
</FONT></SMALL></TD></TR>
</TABLE>
```



1. Cultural Map of Achaia (prefecture of Patras)

From this page you can access information on museums and archaeological sites in the prefecture of Achaia. The copyright of this information belongs to the Hellenic Ministry of Culture. The University of Patras provides this information for demostration purposes only. You can access more information (about 1000 entries of Museums, Archaeological Sites or Monuments) at "ULYSSES", the web server of the Hellenic Ministry of Culture.

Categories: Archaelogical Sites
Museums

For: Cultural Operators, Educational Staff, Tourists

Provided By: University of Patras (Home Page)

Figure 4: Notation for configuring the display of information items

As shown in the next section, we have built several systems for automatically generating hypertext, using information contributed by specialized content providers in certain knowledge areas. From our experience, we have pointed out that in each case, a flexible data-entry system should be implemented with the right level of customization capability, so as not to frustrate the content provider with useless extra features.

6. Applications of the ITC system

During the previous year, ITC has been used in some representative Web sites. The diversity of the target of these sites have helped us in finding out how ITC can operate under different circumstances, by providing cataloging and searching services over well-organized sets of information items. Firstly, ITC has been used to build the Thematic Catalog of two major governmental organizations, the Ministries of Culture [Culture] and Sports [Sports]. In both cases, ITC has been customized for providing a simple interface, so that unskilled content providers may easily populate the catalog with new information items and manage the existing content. Furthermore, a supplementary interface has been embedded allowing external users to propose new information items.

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The ITC system has been also used in a pan-european research-oriented Web site [VHF] where partners from all over Europe have been contributing in a specialized edition of the ITC system, focusing on Tourism and Culture, in which the geographical tool has been embedded. The challenge here has been to implement an efficient multilingual tool for the various content providers from different countries, which could be used for simultaneous manipulation of both the structure and the contents of the Thematic Catalog. The user interface in all content-providers' and end-users' forms is multilingual and is automatically generated by the system. The only data requested by the user in an initial bootstrap-phase was the translation of some key-phrases prompted by the system in all desired languages. The feedback received by the content providers has shown that ITC has proved to be an efficient system for displaying and manipulating the structure and the contents of a catalog.

Finally, ITC has been used in an educational, client-server based environment used for teaching Ancient History in high-school students. The environment is called ISTOPOLIS [Papaterpos 1999] and is currently going under evaluation in some selected High schools. In this case, apart from simply classifying the pages of a Web site, ITC has been used to organize the whole Web site of the environment, that is the content of the information items. The Web site of the environment consists of pages, each of which describes a certain issue in the Ancient History. Before writing the actual content, content providers have used ITC for defining and categorizing the topics that would be covered by the material provided. They defined, in this way, the basic categories and the subcategories of the catalog. The multiple organization of the content in the form of categories provided a *Table of Contents* to content providers that helped them determining what kind of information items it was necessary to write in order to cover every aspect of a certain portion of the Ancient History (in this way similar knowledge areas may be covered). At this point, content providers had to fill the system with the titles and classifications of these information items and write the actual content of these items in a special area embedded in the input form. This application is an example of how the ITC system can be used to help the authoring process of a Web site, apart from its main use, which is the classification of pre-written information items.

7. Conclusions

In many Web sites, Thematic Catalogs constitute an efficient way for navigating through the site's contents. ITC helps automating the process of building such catalogs. Based on the system's application on different sites with varying needs, we have collected valuable feedback that helped us improving many features. One of the main outcomes of this attempt is that given a system with a certain internal structure and functionality, an efficient multilevel interface has to be provided in order for the system to satisfy the various end-users' needs.

8. References

[Styliaras 1998] Styliaras, G. D., Zafiris, P. A. & Papatheodorou, T. S. *Implementing highly configurable Subject Trees: The ITC system.* WebNet' 98, November 7-12, 1998.
[Papaterpos 1999] Papaterpos, C. M., Styliaras, G. D., Tsolis, G. K. & Papatheodorou, T. S. *Architecture and implementation of a network based educational hypermedia system.* IEEE ICMCS '99, June 7-14, 1999.
[Orendorf 1996] Orendorf, J. & Kacmar, C. *A spatial approach to organizing and locating digital libraries and their content.* ACM Digital Libraries 1996.
[VHF] VHF, http://jupiter.cib.na.cnr.it:8080/.
[Java] Java / Swing, http://java.sun.com/products/jfc/.
[XML] Extensible Markup Language, http://www.w3.org/XML.
[Owen 1997] Owen, C., Makedon, F., Frank G. & Kenyon, M. *ASML: Automatic site markup language.* WebNet' 97.
[CFML] Cold Fusion Markup Language, http://www.coldfusion.com
[VBScript] VBScript in Microsoft's Active Server Pages, http://msdn.microsoft.com/scripting/vbscript/default.htm
[Culture] Web site of the Ministry of Culture, http://www.culture.gr/7/index.htm
[Sports] Web site of the General Secretariat of Sports, http://kronos.sport.gov.gr/Sports_Sites/index.htm

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Discursive Evaluation

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Abstract : This paper reports on a distance education project where a threaded discussion board was used for interaction amongst students and teachers. The experiences from the first year of the project shows that such a forum can be an important complement to other evaluative resources in order to monitor student's expectations and experiences. Vital properties of the discussion board are that it is continuos, online, public, asynchronous and auto-structuring.

1 Evaluation in Distance Education

Evaluation is an important tool in higher education, guiding faculty and management towards better courses with improved methods of teaching and administration. The literature describes many formal techniques and instruments for this purpose (i.e. Oliver 1997). Since most methods for evaluation require substantial resources for measuring as well as analysis, the dominating instrument is probably a simple written post-course questionnaire with multiple choice questions and/or open-ended short comments (Hall 1997). In addition to the results from formal evaluation, teachers have a rich flow of more informal and sometimes sublime feedback arriving continuously from a variety of sources. Casual conversation with students and colleagues, the atmosphere in classroom and corridors and student's body language and degree of attention during a lecture can all be viewed as carriers of evaluative feedback. In a distance educational setting, with students and teachers separated in time and space, these signals are drastically reduced. To compensate for this type of informal communication with computer-mediated interaction is difficult, if even possible. Whittaker et al (1994) addresses the general issue of designing IT to support informal workplace communication, arriving at the conclusion that a shared workspace is an important aspect and that rich synchronous video-media and asynchronous text based media should be combined and integrated when aiming for an acceptable design.

The focus of this paper is a threaded discussion board where students and teachers meet to discuss and course related issues. This is an informal arena where students can express their attitudes, opinions, perceptions and experiences. Such a forum can serve as a valuable complement to traditional post course questionnaires, even making it possible for teachers to challenge and manage these student-opinions.

The arguments are based on experiences from a distance education project at a university in Sweden. The empirical data of the study are the entries made by students and teachers to a web-based computer conference (discussion-board). This conference is integrated into a web-education system, called DisCo, developed at the University. The entries have been analyzed with respect to evaluative factors like topic and nature.

2 The Case Setting

The object of the study is a distance education project where 60 students from six small communities in the outlying districts of a Swedish university can take a degree in System Analysis (B. Sc.). The participating communities were committed to provide some basic facilities such as access to modern computers with Internet-connection, a prescribed set of software packages, a videoconference(VC)-studio and room for collaborative work.. The number of students in the various communities varies from five to 17. The study covers the courses during the first year of the project. All courses had different teams of teachers and different methods of teaching and examination. The courses were in order: (1) *Mathematics and Statistics, 10 weeks, (2) Computer Science, 10* *weeks, (3) Business administration, 10 weeks, (4) Finance, 5 weeks and (5) C++ Programming, 5 weeks.*

A common denominator in all courses was the use of learning technologies. Multiparty VC-sessions were used for lectures, seminars and presentations, and a web education tool (DisCo) was used for distribution of course material and for text based interaction. The DisCo-system provides a website for each course, one of its components being the core object for this paper, namely the Discussion Board. - A primitive web-based conference, where discussion topics are divided into threads presented on the screen with indents that indicates the structure of the discussions. Each entry is presented with a hyperlinked title, a date/time-stamp and the signature of the author. The threads are sorted in descending time order with respect to the first entry of each thread. An entry is displayed in full text by clicking on the title, it is then possible to choose to post a follow up to the entry. In addition to text (with html-tags if so desired) the author of an entry can choose to submit a picture, a URL and or an email address. Each entry should be signed with a name or a pseudonym by the author. A new discussion-thread is started in the same manner.

Laurillard (1993) classifies the debate board to be a discursive media. Using her conversational framework she claims that discursive media addresses interaction at the level of description and reflection upon actions, feedback and goals. Long & Baecker (1997) emphasizes the conversational style of a debate board, allowing for conversation among groups where each person can respond to all others, having the complete dialog-history displayed.

3 Research Approach

In a previous study the email and discussion-board entries of the course in Mathematics and Statistics have been analyzed using a method designed by Orlikowski and Yates (1994). This method uses the concept of Genre to detect patterns in the electronic interaction. Orlikowski and Yates defines a genre to be a:

> *Typified communicative act having a socially defined and recognized communicative purpose with regard to its audience.*

The Genre concept accounts for both the substance and the form of the interaction. Substance refers to the topics and the discursive structure of the interaction, and form has three sub-dimensions: structural features, communication medium and language. The concept of a Genre Repertoire (ibid.) refers to a set of genres providing a social template for communication within a community. The audience or community in this case is of course the group of students and staff (teachers, course-administrators) interacting through the DisCo-system. The result indicated a genre repertoire consisting of three distinct genres appearing both on the debate board an in the email to teachers. The genres were labeled Query, Feedback and Smalltalk (See Svensson 1998b for a thorough discussion).

The Query genre was characterized by having the primary purpose of discussing exercises and aspects of the course literature. The purpose of the Smalltalk-entries is to entertain, and socialize even though the content is often related to some course activity. Social activities like this are often reported in distance learning projects, (see Fjuk 1998), and serves an important role in building and maintaining the learning community. These entries can to some extent be a substitute for the sublime feedback signaling the mood of the students discussed in the first section. However the focus in this paper is more directly linked to the Feedback genre which constitutes the foundation for the analysis reported in this paper.

4 Data collection and analysis:

The aim of this explorative study is to present as rich a picture as possible of the nature of the evaluative discourses that took place on the discussion-boards. The primary unit of analysis is the discussion-thread. All threads with an evaluative content are included in the study. The threads where classified with respect to the feedback-topic(s) being discussed (see table 1). Secondly each debate-board entry was analyzed with respect to the nature of the feedback. Inspired by the classification of different types of feedback a teacher can give a student presented by Draper (1997b), the following scheme was adopted. The entries were classified into one or more of these feedback types. Some simple quantitative measures such as number of entries, the number of follow up levels and the time-span between first and last entry was recorded in order to give complementary

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information on the nature of the debate. In addition to analyzing the debate-entries the log-files containing data on all visits to the debate boards were analyzed.

Topic	Description
Course-Context	Comments on administrative issues, student-facilities or service
Course-Content	Assignments, Course-Material, Topics of study, literature etc.
Learning Technology	Comments on Videoconference or issues related to DisCo (tech problems, features etc.)
Teacher performance	Comments on lectures and tutoring
Debate Climate	Comments on the form or style of other debaters.

Table 1: Classification of threads

Feedback types
1. Agree/Disagree with other debater
2. Success/Failure: Debater stating that something is bad (or good)
3. Behavior recipe: Debater presenting a suggestion for change
4. Explanation: Elaboration on why something is wrong (or right)

Table 2: The different natures of feedback

5 Result

The log-file data shows that the discussion-boards have been frequently visited. A total of over 12 000 visits over a 40 week period. This resulted in 223 threads with 563 entries. (One out of 20 readers posted to the board). 50% percent of the threads (60 % of the entries) were classified as feedback-threads and therefor included in the study. The topic-analyses revealed that a majority of the evaluative threads focused on one and sometimes two topic-categories. (see table 3)

Topic of feedback	Math/Stat	Comp.Science	Bus.Admin	Finance	Programming
Context	4	1	7	3	6
Content	4	10	6	1	2
Technology	16	9	9	1	2
Teacher	5	1	1	3	0
Discussion	1	2	3	1	1

Disc/Content	0	1	0	0	0
Teach/Content	2	4	2	0	0
Teach/Tech	0	4	0	0	0
TOTAL	32	32	28	9	11

Table 3: Number of entries per feedback-topic and course

Comparing the courses shows that the debate-frequency is fairly equal in the first three courses, and dropping slightly in the last two. Also the length of the threads drops from an average of 3-4 in the first 30 weeks, till no more than 2 in the last ten weeks. The fact that the 5-week courses tend to be more intense could be one possible explanation. Another explanation could be that the fact that issues related to the DisCo-system were frequently debated in the first courses (, but gradually the system has become more and more transparent to the student's and is therefore not an interesting topic to debate. In the latter courses the technology threads relates to how it is operated by teachers and integrated with course content. The short threads and solo entries could be found in all categories, but dominated in Learning technology and Debate climate. The longest discussions are concerned with the context or the content of the courses.

The lifetime of most discussions were very short (1 or 2 days). Only three threads have a span of more than a week between the first and the last entry. One explanation to this could perhaps be found in the graphical interface of the debate board. Since the complete dialog history is presented on the screen, the threads disappear from the start-screen of the board after 15 – 20 entries have been made. Then the scroll-bars must be used in order to read the entries or post a follow up. There were some examples where debaters chose to start a new thread continuing the debate on an existing topic, instead of adding to the original thread.

In table 4, the entries are divided with respect to the nature of feedback. It is worth noticing that an elaborate explanation or a suggestion for changes is included in 53 percent of the entries, leaving only 47 percent with short-answer-like reports on success or failure or commenting someone else's opinion.

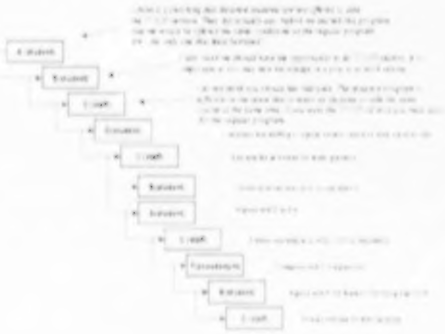
Cat	**Description**	**Math**	**Comp.Sci**	**Bus. Admin**	**Finance**	**Programming**	**Total**
1	Agree/Disagree (A/D)	17	13	24	4	5	63 (18%)
2	Success/Failure (S/F):	34	30	21	8	9	102 (29 %)
3	Behaviour recipe (BR):	5	5	14	1	3	28 (8 %)
4	Explanation (Exp)	15	18	17	4	10	64 (18 %)
1 & 3	A/D with BR	1	1	2	0	0	4 (1 %)
1 & 4	A/D with Exp	3	6	10	0	1	20 (6 %)
2 & 3	S/F with BR	4	9	4	0	0	17 (5 %)
2 & 4	S/F with Exp	9	8	3	1	1	22 (6 %)
3 & 4	BR with Exp	1	3	2	0	1	7 (2 %)

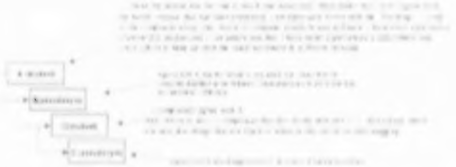
-	Others	1	4	11	1	3	20 (6 %)

Table 4: Number of entries per feedback-type and course

In order to visualize the debate, two examples of threads are presented below. The first example deals with the debate climate of the second course as well as the use of outdated software. The second thread is from the computer-science course and deals with a course-context issue. The header of the first entry was "Why not COOP??", referring to the fact that students on the distance education program did not have the opportunity to integrate work-placements with their studies.

Descriptions in italics are translations from debate-board entries (in some cases, somewhat shortened)





6 Characterizing the Discursive Evaluation

It is important to emphasize that the opinions expressed by students on the debate-boards cannot be uncritically regarded as being representative for the whole community. Hall (1997) and Wheeler (1997) argue that studying computer-conference interaction can be biased by the fact that students tend to participate in the debate to a varying extent. Hall claims that technology-friendly students are quicker in adopting the media and will therefore be over-represented. Issues such as fear for lack of anonymity and reluctance to express ones opinion in writing could imply that some students hesitate to participate in the debate. The students in this study can however all be assumed to be reasonably positive in their attitude towards computer technology, since they are studying for a degree in System Analysis. Furthermore, the familiar and 'talk-like' language generally reported to be a characteristic of text based computer-interaction, (Sproull & Kiesler 1991, Ljungberg 1997), could enhance the wish to express written opinions compared to other evaluation techniques like open-ended questionnaires. In a distance educational setting when students and teachers seldom meet face-to-face, it can be difficult to keep track of students' attitudes (Hall 1997). The discursive nature of the debate board is very well suited for both discovering these perhaps diverse expectations, and even manage them by explaining and elaborating. Hall (1997) reaches similar viewpoints. She says that using the content of a computer-conference for evaluative

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purposes could be prosperous when wanting to find personal, subjective opinions among students. The illuminating qualities of the debate, reported in this study, would serve as a good complement to a post-course questionnaire. Such questionnaires are perhaps more valid in terms of representing the attitudes of the whole community, but often suffer from short comments without elaborated explanations on complaints and suggestions.

There are several important properties of the debate board itself, which can separately as well as collectively contribute to the way it used. In addition to these qualities there are of course also other essential factors of the learning context that will effect the outcome.

(1) *The debate is Public*: The fact that all entries can be read by everyone in the community serves at least three essential purposes. Firstly, the risk of minority-opinions being overestimated is reduced since such entries is likely to be contradicted by others. Secondly it makes it more interesting for students to express an opinion when they know that it will be read by more people than the teacher. A third feature related to the public nature of the board is its social functions. The existence of the Smalltalk genre (Svensson 1998a, 1998b) points to the fact that students use the board for social purposes. It can not be ruled out that an evaluative entry to the board is more of a social action than a wish to give feedback.

(2) *The threads are Auto-structuring* :. The entries are automatically sorted into threads, making topic-oriented analysis easier for an evaluator or teacher. If the debate is regulated (i.e. suggested topics for discussion) the threads can still provide good structure with respect to sub-issues. However if the regulation is too strict, there is a risk of loosing the discursive structure supported by the threads. At a point it will become arbitrary whether a new entry should start a new thread or add to an existing one.

(3) *The medium is Asynchronous*: Laurillard (1993) argues that the asynchronous nature of discursive media can contribute to students making entries more carefully thought trough and 'well formulated', reducing the risk for misunderstandings in analyzing the content. Draper (1997a) argues that reflecting on ones own writing, is a form of 'self-feedback' that promotes learning. In the same way, taking time to reflect on other debater's viewpoints can induce a similar intellectual process.

(4) *The discussion is Continuous and Online*: Draper et al (1996) says that an important constraint in evaluation is not to overload students. On the debate board they only express their opinion when the want to do so. This is not the case in traditional post-course evaluations where many issues worth giving comments on are long since forgotten. Furthermore, the possibility that suggested changes could be implemented and reported errors could be dealt with is likely to enhance students' willingness to give constructive feedback.

7 Conclusions

The key qualities of the board all contribute to form the nature of the discussions. The results from the case study show discussions in many course-related topics, rich on constructive suggestions and argumentation. This feedback could be a valuable input for teachers, but perhaps even more important, it makes it possible to challenge and influence students' attitudes and expectations. Especially in distance educational settings, where students and teachers seldom meet in person, it is important to identify ways of picking up sentiments and sources of irritation. A discursive media like the discussion board presented in this paper should not be perceived as a formal instrument for objectively evaluating a learning context. On the contrary, it is a forum for conversations and discussions for the learning community of students and teachers, perhaps to some extent compensating for the loss of informal communication-channels of the campus based education. Thereby making it possible for teachers to monitor students' opinions and influence them at the same time. What better way to change someone's opinion than to engage in a discussion.

8 References

Draper, Brown, Henderson, McAteer (1996) Integrative evaluation: An emerging role for classroom studies of CAL. *Computers&Education vol. 26* no. 1-3 (p 17 - 32)

Draper, S W (1997a) Niche-based Success in CAL *Procedings of CAL'97*

Draper, S W. (1997b) *Feedback*. Available at URL http://www.psy.gla.ac.uk/~steve

Fjuk, A (1998) *Computer Support for Distributed Collaborative Learning: Exploring a complex problem area.* Dr. Scient.

Thesis 5 University of Oslo, Department of Informatics

Hall, J (1997) Evaluating new technologies for teaching and learning in distance education: current and future developments The New Learning Environments, a global perspectives, *proceedings from the 18th ICDEWorld Conference*.The Pennsylvania State University.

Laurillard, D (1993) *Rethinking University Teaching: a framework for the effective use of educational technology*, Routledge, London

Ljungberg, J (1997) *From Workflow to Conversation* - Doctoral Thesis University of Gothenbourgh, dept. Of Informatics

Long, B & Baeker, R (1997) A Taxonomy of Internet Communication Tools. *Procedings of WebNet 97*, AACE

Oliver, M (1997) *A framework for evaluating the use of educational technology*. - Available at http://www.unl.ac.uk/latid/elt/

Orlikowski, Wanda and Joanne Yates. (1994). "Genre Repertoire: The Structuring of Communicative Practices in Organizations," Administrative Science Quarterly 39: 541-574.

Sproull & Kiesler (1991) Connections: *New ways of working in the networked organization*. The MIT Press, Cambridge Massachusetts

Svensson, L (1998a) Genre Repertoire – *Procedings of WebNet 98* - AACE

Svensson, L (1998b) Query, Feedback and Smalltalk: Genre Repertoire in a distance Education Project - *Procedings of IRIS 21*

Whittaker, S Frohlich, D & Daly-Jones, O (1994) Informal Workplace Communication: What is it like and how might we support it?, in *Human Factors in Computing Systems. CHI-94-4/94* Boston, Massachusetts USA

Wheeler, S (1997) *A framework for open & distance learning: Modes, methods and issues*, Paper presented at CAL 97, Exeter university.

Enhancing Science and Technology Education: Pattern-based Learning and Curriculum Leading to Web Deployable Courseware

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Abstract: This paper reports our project on enhancing science and technology education. Curriculum development that integrates a pattern-based learning concept into the design of lesson plans and web deployable courseware will be described. This project serves as a vehicle for the "proof-of-concept" on the proposed pattern-based learning concept, and as a mechanism for evaluation and assessment of the learning concept. With the experience gained, pedagogy based on pattern-based learning is realized and serves as a blueprint for the development of web deployable courseware. The development of web deployable courseware for content materials specific to mathematically oriented science concepts will also be briefly described.

1. Introduction

This paper presents our experience on curriculum development and on introducing a conceptual learning tool for web-based courseware development to enhance science and technology education. This project is part of the effort on a program funded by the NSF DUE division for enhancing undergraduate science and technology education. There are two groups of targeted audience. The first group is the freshman and sophomore students who may be or have already been majoring in a science or technology discipline. The second group is the senior and graduate students in Computer Science.

There are three major components of the NSF ILI funded program. The first component consists of two parts. The first part is a course curriculum development. A new undergraduate introductory course CS86 --- Science Problem Solving using Computing Tools --- was developed and implemented in Fall/98. The second part is the curriculum enhancement on a graduate course CS762 ---Algorithms based on Probability Methods. The second component of the project is a "proof-of-concept" feasibility study on a conceptual learning tool that has been integrated into the course activities. The process of "proof-of-concept" has led to the development of a set of web-based courseware for CS86 and CS762. The third component of the project is the development of web-based courseware that can be accessed by students anywhere in the Internet with an ActiveX enabled Internet Explorer browser and the Mathcad OLE2 automation server [Mathsoft 1998][Simon 1997].

This paper will focus on the first two components of the project, while the third component will only be briefly described due to the page limit. In the next section we will first describe the profile of our institution and the backgrounds of our students, and the process leading to the development of the course CS86 and the course enhancement for CS762. We will then detail a conceptual learning tool that is based on the concept of patterns. An illustration will follow to demonstrate how various physics and mathematics concepts can be presented within the model of pattern-based learning. Finally, we will discuss our experience on the curriculum development and the student reactions on the courseware evolved from the concept of pattern-based learning.

2. Background

The City University of New York (CUNY) is comprised of seventeen colleges with a student population of about 200,000. Our college is one of these colleges with a student population of 18,000 in the undergraduate and graduate programs. Among them about 1500 are enrolled in the undergraduate science

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programs, and 40 are enrolled in the pre-engineering program. Within the Computer Science Department, there are about 500 undergraduate students and 200 graduate students. Since our college is a commuting college, many students are residents of the local community, and are the first generation immigrants who have been in this country for less than five years.

One of the highest priorities of our college is to improve the science programs to be more inclusive so that science student population reflects our diverse student population. Cross discipline collaboration is traditionally appealing within our college and viewed as a viable strategy to increase the likelihood of exposing students to science disciplines, even some of these students may not eventually be majoring in science but could still benefit tremendously from increased "science awareness".

Although there are efforts on cross discipline collaboration, most active collaborations often remain in faculty research with limited opportunities for students. We conclude an important first step to stimulate students excitement, and to prepare and engage students in science is the development of a science problem solving course that will offer students general science education and prepare them to participate in cross discipline collaborative science activities. Towards this end, we have developed a course "science problem solving using computing tools" (CS86) [Sy 1997] in which students were introduced to science problems that span cross disciplines and touch their daily life. For example, students will be guided to access the World Wide Web and download from the U.S. Census Bureau [Census Bureau] personal income survey data to determine through a simple statistical analysis on any possible correlation between the age and the personal income.

Another equally important group of student population we focus on is the senior and graduate students majoring in Computer Science. This group of students has been trained traditionally on solving computational problems through analytical algorithmic approach or experimental system approach. However, their exposure to applying learned approaches to solve practical problems may vary from individual to individual depending upon their backgrounds. For example, students may master a theoretical computational algorithm for string match problems, but lack the real world experience on applying it to, for example, promoter detection in DNA alignment problem in molecular biology [Clark and Russell 1997]. Towards this end, we have decided to enhance our course "Algorithms based on Probability Methods" by providing software tools for analyzing data from cross disciplines of science/technology. In order to bring the practical aspects of the analysis of algorithms, the tools just mentioned are web-based in the form of ActiveX components for statistical data analysis and for probability model discovery. These tools are located in the web site listed in [Sy 1998] and the details of access will be presented in the conference. An example of the course activities is the analysis of the interior-point optimization algorithm with a primal-dual formulation [Wright 1997]; where the analysis would be based on a practical application of the algorithm to discover an optimal model useful for reasoning about social patterns, or the molecular structure of musk.

Due to the diversities on cultural backgrounds and language proficiency among our student population, students often have different perspectives on a concept introduced to them. This is particularly evident when students engage in class discussions through topic-centered collaborative learning. In addition, we have observed various learning patterns among our diverse student population. For example, many students with oriental cultural background seem to take an approach that is mathematically oriented, and skill-based practice, leading up to the understanding of an abstract concept. On the other hand, students with English as their first language tend to take an approach that is "word-based reasoning" leading to a mental visualization of an abstract concept. Our observation on learning patterns among students is consistent with a recent report by Stigler [Stigler and Hiebert 1998] suggesting that teaching is a cultural activity.

3. Pattern-based Learning

Given the observation just mentioned, we ask two fundamental questions related to enhancing science and technology education for a student population with diverse backgrounds:
1. Within an instructional environment where a diverse student population may incline to different approaches for learning, what are the common characteristics among these different learning approaches?

In other words, from a learning-centered perspective, is it possible to have a unified learning model that can encompass and provide linkages among different learning approaches?
2. How do we develop instructional techniques and teaching environment that can accommodate different learning approaches and are pedagogically sound? From an instruction-centered perspective, how do we develop courseware that would deliver effective learning, even the preferred learning approach of individuals may vary?

We hypothesize the concept of patterns may provide a linkage among various learning approaches. In our preliminary study, we will focus on one particular aspect of science and technology training --- modeling --- a process often involved in engineering design and scientific analysis.

Loosely defined, patterns may refer to regularities exhibited in a phenomenon, or the existence of certain structures in an entity of particular interest. For example, tornado and twister are weather phenomenon with a spiral rotating wind circulation. "DNA" is a polymer made up of a linear component of sub-units known as "nucleotides" --- composed of phosphate, sugar, and base [Clark and Russell 1997]; where there are four bases: A (Adenine), T (Thymine), G (Guanine), and C (Cytosine).

In our project, we elaborate on the concept of patterns [Grenander 1993 & 1996] to develop a pattern-based learning framework. Within our proposed pattern-based learning framework, the foundation of learning a science/technology concept is based on the discovery process for identifying a set of patterns that represents the concept. Various learning methodologies [Mestre 1995] have been proposed and studied for exploratory discovery process. We concentrate on the formalism of developing a mental model for a concept to be learned through the set of patterns resulted from the exploratory discovery process.

The essence of our proposed pattern-based learning lies on formalism that information coded in patterns can be explicitly represented as a mathematical structure, a visual model, or a graphical model. A mathematical structure could be simply a sequence such as a geometric series, a system of differential systems such as Lorenz equation for weather modeling, or a complex dynamical system for solving "traveling salesman problem" [Banzhaf 1989]. A visual model for representing information coded in patterns could be various kinds of simple plots such as simple 2D/3D scattered plots, surface contour plots, sophisticated Trellis graph or QQ-plot [Mathsoft 1997], or complex high dimensional scientific visualization [Nielson et al 1990]. Yet another useful representation of patterns is a graphical model of functional dependency. For example, projectile motion of a ground-to-air missile reveals a pattern that its (vertical and horizontal) displacement is functional dependent on the initial velocity and initial angle of projection. The functional relationship among the displacement(s), initial velocity, and initial angle can be shown in a dependency network that graphically displays the structure of the functional dependency among these parameters. We will show such a graphical model in the conference presentation via Internet access to one of our web-based courseware that represents a simplified version of functional dependence between aerodynamics and flight control.

An important aspect of the proposed pattern-based learning technique is the inter-relationship among the three different kinds of representation. A mathematical structure that captures the behavior of patterns is an abstraction of the corresponding concept (or physical phenomenon) in terms of functional expressions. Such functional expressions could be in an open form such as a Taylor series or a close form such as a formula for a geometric series [Grenander 1993 & 1996]. A visual model is an abstraction of the corresponding concept (or physical phenomenon) that is based on a data-driven approach to provide a visual perception of the behavior of a pattern [Miller 1986]. A graphical model is an abstraction process that attempts to capture the qualitative "causal" relationships among the parameters needed to describe a concept/phenomenon [Pearl 1988].

There are three processes associated with the proposed pattern-based learning technique: synthesis, analysis, and summary. Given a mathematical structure, one can synthesize data from the functional expressions. The data synthesized is a source for constructing a visual model that is based on data-driven approach. Given a visual model, a learner's task is to summarize the observed relationship in terms of qualitative causal or dependency relationships in a graphical network form. This concept is not unusual as evidenced by the notion of concept map in education community [Gange et al 1988] and belief network in AI community [Pearl 1988]. In reverse, one can analyze a given set of data in an attempt to discover the functional expression. Or given a graphical dependency model, one can try to discover a mathematical model through which one can use the functional model to derive data for constructing a visual model.

4. Illustration

Projectile motion is a concept commonly used to illustrate the law of motion in Physics. The law of motion describes the inter-relationship among the displacement of an object in relation to its initial velocity, initial angle of projection, and acceleration. The change in the position of an object can be calculated using the equation that characterizes the law of motion. In particular, the vertical displacement at time t is $S_y(t) = ut \sin(A) - 0.5gt^2$, where u is the initial velocity, A is the initial angle of projection, g is the gravitational constant, and t is the time elapse. Similarly, the horizontal displacement at time t is $S_x(t) = ut \cos(A)$. The position of an object in projectile motion $(S_x(t), S_y(t))$ can be computed using the mathematical equations just shown. These two equations are the functional expressions that underlie the mathematical structure of the projectile motion.

Using the functional expression of the projectile motion, one can generate a set of data $(x(t),y(t))$ that corresponds to the position of the object at time t, with $x(0)=y(0)=0$. If $(x(t), y(t))$ is plot one-at-a-time on a x-y axis, the animation of the plot shows the projectile motion. This animation presents a visual model of the projectile motion. The change in the maximum horizontal and vertical displacement can be observed when the initial velocity or the initial angle is changed. The dependency of the maximum horizontal and vertical displacement on the initial velocity and initial angle can be shown in a graphical network model similar to a Bayesian network [Pearl 1988].

In pattern-based learning, a learner may first make observations on the change of projectile motion in relation to the change of initial velocity and angle. This first step is to engage the learner in a discovery process to identify patterns of projectile motion and to develop a "mental visual model" of the projectile motion. The learner will hypothesize the relationship among the changes in displacement, initial velocity and angle. Then a graphical dependency model will be constructed to reveal the hypothesized relationship. At the same time, the learner may take measurements on the change of vertical and horizontal displacement over time for various fixed settings of initial velocity and initial angle. With the measurement data on hand, the learner can perform a reverse engineering process by deriving a functional expression for the horizontal displacement with time as the independent variable on a fixed initial velocity and angle, and similarly a functional expression for the vertical displacement.

The pattern-based learning process just described is an exploratory approach where a learner begins the learning process by making connection between his/her internal experience with the observations made for the external physical phenomenon. There are two end products of this step: a mental visual model and a graphical dependency model. The next step of the learning process is to discover the mathematical structure of the concept of the projectile motion. A point noteworthy is that these steps can be applied in a reverse order to engage a student in the pattern-based learning if the student prefers a more mathematically oriented approach on learning a new concept. Yet another point noteworthy is the built-in mechanism for assessing learning. Consider the case where a learner hypothesizes a positive linear relationship between the maximum vertical displacement and the initial angle by overlooking the critical turning point 45 degrees, a simulation based on synthesizing a visual model will reveal a discrepancy between the simulated and observed projectile motions. We will illustrate this point further during presentation using a web deployable courseware that runs on a PC with a Mathcad/Mathconnex automation server.

5. Web Courseware and Dissemination

The web deployable courseware of our project consists of three tasks: (1) content material development, (2) media presentation and application feature, and (3) dissemination. Currently we focus on developing courseware for content materials that involve mathematically oriented concepts, in particular, those concepts that are difficult to our students; e.g., system equations for projectile motion in CS86, or the computational geometry of hyper-tetrahedron that encompasses all possible discrete multi-variant probability models.

As noted from our students, math and science understanding are often related to the ability to visualize. Therefore, an important consideration of our courseware development is the visualization feature for a student to explore visually the mathematical structure behind a difficult concept. Our approach is to adapt proven authoring tools such as the one by Mathsoft Inc. for courseware development. The courseware will be in a form of electronic books that provide 'live' formulas where the data can be manipulated, graphed, or even animated [Spiegel 1989] [Edminister 1995]. These electronic books are not just a textbook in an electronic form, but a new media providing new modalities for learning. Integrating new modalities with traditional text-based modality is particularly well suited for our proposed pattern-based learning approach, which is a significant and integral part of our project on enhancing science and technology education. Using these new modalities, students can apply the conceptual learning tool --- pattern-based learning --- to gain a greater insight into visual reasoning behind the numbers and their mathematical relationship.

Currently our dissemination strategy on the web is on a vertical scale. That is, we adapt one environment for authoring and accessing the courseware. Namely, our environment is on Microsoft operating systems (Windows 95, 98, or NT), and the web browser is ActiveX enabled Internet Explorer. Within this environment, the authoring and computing tools are Mathcad by Mathsoft Inc., the data exchange is mostly on Microsoft Office and Mathcad OLE automation servers, and the programming development environment is by Inprise (former Borland). This strategy works well within our local community since we involve in the planning and implementation phase of building the infrastructure to support dissemination to our students. This strategy, however, has yet to be found out its effectiveness beyond our local community. Below is a list of issues to be explored:

1. Our courseware is tied to pedagogy based on pattern-based learning that seems to work well with our students. How effective is our courseware on students in a different community, and perhaps even with different learning attitudes due to the cultural differences; e.g., foreign students as compared to students went to the high schools in the US, or students in different geographical localities?
2. Currently our courseware is deployed via the web, but require Mathcad OLE2 automation server, as well as Internet Explorer (IE) with ActiveX capability (i.e., IE 3.0 or above), and Microsoft Office OLE automation servers for data exchange. Is this requirement on the resources a reasonable expectation on the audience outside our college who can benefit from our courseware?
3. It is conceivable that different campuses may have their unique characteristics in terms of the choice of approaches and tools to best suit their students. What are the (additional) resources required for cross campus dissemination with respect to the support for courseware customization, media and technical support, as well as lesson plan development?

6. Conclusion

This paper presented the major components of our NSF project for enhancing science and technology education. We have discussed the curriculum development and enhancement of two courses to make our science programs more inclusive so that our science students reflect the diversity of our student population.

Due to the diversity of our student population, we noted that students generally take different approaches in learning a new concept. We have presented a learning approach based on the concept of patterns. It is our hope that this proposed pattern-based learning would serve as a linkage for bridging various learning approaches taken by students. A set of web deployable courseware has been developed to help students engaged in pattern-based learning. In our preliminary assessment, we found students responded favorably to our proposed pattern-based learning. This is in part due to the rich variety of representations that provide different perspectives for understanding concepts which may otherwise too difficult for students to grasp.

The favorable response from students is an indication of "proof-of-concept" for our proposed pattern-based learning. As a consequence, we plan to make our courseware accessible to not only just the audience inside our college, but are currently exploring possible dissemination of our courseware (and its application to enable pattern-based learning) beyond our college through web deployment. Further details about our courseware development and dissemination will be reported in an upcoming workshop supported by the faculty development program of the Research Foundation of the City University of New York.

7. References

[Banzhaf 1989] Banzhaf W. (1989) Physics Letter A, 136, 1, 2, 45-51.

[Census Bureau] Bureau of Census, U.S. Department of Census, Data depository Center/Data Extraction System: http://www.census.gov/des/.

[Clark and Russell 1997] Clark D. and Russell L. (1997) Molecular Biology: made simple and fun, Cache River Press, ISDN 0-9627422-9-5.

[Edminister 1995] Edminister, Joseph A., *Schaum's Interactive Outline Series: Electromagnetics*, McGraw-Hill, New York, NY.ISBN 0-07-842713-4.

[Gagne et al 1988] Gagne R., Briggs L., Wagner W. (1988) Principles of instructional design, New York: Holt, Rinehart, and Winston.

[Grenander 1993] Grenander U. (1993) General Pattern Theory, Oxford University Press, Oxford.

[Grenander 1996] Grenander U. (1996) Elements of Pattern Theory, The John Hopkins University Press, ISBN 0-8018-5187-4.

[Mathsoft 1997] Mathsoft (1997) S-PLUS 4 User Guide, Mathsoft.

[Mathsoft 1998] MathSoft (1998) Mathcad 8 User's Guide, Mathsoft.

[Mestre 1995] Mestre J.P. (1995) "Cognitive Aspects of Learning and Teaching Science," in S.J. Fitzsimmons and L.C. Kerplelman (eds.) Washington D.C.: NSF.

[Miller 1986] Miller A. (1986) Imagery in Scientific Thought, the MIT press, ISBN 0-262-63104-0.

[Nielson et al. 1990] Nielson G., Shriver B., Rosenblum L. (1990) (eds.) Visualization in Scientific Computing, Los Alamitos, CA.

[Pearl 1988] Pearl J. (1988) Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference. Morgan Kaufmann, San Mateo, CA.

[Simon 1997] Simon B. (1997) "Tech Apps Take to the Web," PC Magazine, Vol. 16 No. 17.

[Spiegel 1989] Spiegel, Murray R. and DiFranco, Donna, *Schaum's Electronic Tutor of Statistics*, McGraw Hill, New York, NY.ISBN 0-07-060234-4.

[Sy 1997] Sy B. (1997) tweety.geol.qc.edu/nsf/course/cs86.html, tweety.geol.qc.edu/course/cs86plan.html

[Sy 1998] Sy B. (1998) http://tweety.geol.qc.edu/nsf/demo/DeployX.html

[Stigler and Hiebert 1998] Stigler J. and Hiebert J. (1998) "Teaching is a cultural activity," Winter, American Educator Magazine, AFT.

[Wright 1997] Wright S. (1997) Primal-Dual Interior-Point Methods, SIAM, ISBN 0-89871-382-X.

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Student 2000: Net-based Learning for the Next Millenium

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Abstract: Luleå University of Technology has for the last few years deployed a net-based learning environment, mStar, to distribute courses to students independent of time and geographic distance. The mStar enviroment gives remotely attending students equal possibilities as traditionally attending students to take an active part of a course, as well as enhancing the learning experience for all students. This is made possible through a novel combination of IP-multicast technology and the WWW. This paper reports on experiences gained over a few years of practice and depicts a vision of the next generation of the mStar environment.

1. Introduction

If the Internet is the next industrial revolution, then net-based learning may be the next educational revolution [Synnes et al. 1998]. The evidence of this is clearly present at most major universities and companies, where the WWW is used to distribute information to students. Many environments have been presented at past WWW conferences and we can today see that the technology is maturing as usage is increasing.

Some of the early educational uses of the WWW [Perron 1994][Goldberg et al. 1995][Ibrahim et al. 1995] and virtual classroom environments [Lai et al. 1995] have been a major influence for this educational revolution. The availability of course related information such as lecture notes, extra course material, exercises, and course schedules blended with the WWW's inherent qualities such as hyperlinks and accessibility have added much information to the classical structure of courses.

A common deficiency found in these early environments are the lack of support for spontaneous interaction between students and teachers. Additional functionality like real-time textual chat and video conferencing has enhanced communication, creating environments that are near to complete in functionality. The mStar environment [Parnes 1997a][Parnes et al. 1997b][Synnes et al. 1998] is a fully symmetric and distributed system for net-based learning that include the necessary support for spontanous interaction between students and teachers.

Although the mStar environment is functionally well equipped, the usage of it is still immature. Courses at Luleå University of Technology, LTU, are still given in the traditional way, with lectures and laborations, and students are not using the available possibilities of interaction.

This paper reports on experience gained from a wide use of the mStar environment for over three years and depicts a vision of the development of net-based learning using this environment in the next millenium. The paper consists of a brief background, a presentation of how the mStar environment is used at LTU today, and finally a discussion on how a future environment could be like.

1.1 Background

One of the major driving forces behind the Centre for Distance-spanning Technology, CDT, is to deploy net-based learning in the county of Norrbotten. The reasons for this is quite evident: a sparse population in a large geographical area, a decrease in funding while students increase in number, a higher demand from industry for post graduate studies, and the increasing problem of finding competent teachers.

Thus, many high-schools cannot gather the critical mass, funding and competence to offer the courses and subjects that are possible in the more densely populated areas. By giving multimedia- and WWW-based courses over the networks, a sufficient critical mass is generated, creating a county-wide virtual university with breadth and quality that might otherwise not be possible. This virtual university can also be used to guarantee life-long learning aspects, where people continously can take net-based courses that does not demand their full workday attention. This is becoming more important as people without a university level degree have increasing problems to find work, at the same time as it has become economically harder to complete a full university level education.

LTU have given a large number of distributed courses using the mStar environment, ranging from graduate-courses to full fledged under-graduate courses. The university has achieved a significant deployment and usage of distributed education over the Internet, not only internally but also to other companies and organisations in the county. Giving joint courses might help bridge the gap between local industry and the university.

This paper therefore presents the concrete results of a wide deployment effort of the mStar environment for distributed education where secondary schools, the university, local companies and communities are all active participants. We are now only starting to see the first social and cultural changes within the schools and companies involved. The paper also depicts the vision of the future use and continuation of the net-based learning efforts at LTU.

2. Net-based Learning Using the mStar Environment

The mStar environment is a collection of tools that span from preparation to presentation. The tools are flexible enough to be useable in many educational scenarios, from large scale lectures to small group activities.

Note that by combining the possibilities offered by available networks, the accessibility and ease of use of the WWW and the benefits of IP-multicast [Deering 1991], we have been able to make these scenarios a part of our everyday, real-life teaching experiences. We would like to stress that this is a working system in real use.

This chapter means to briefly describe the current use of these tools, as well as some lessons learned.

2.1 Large Scale Distributed Lectures

The traditional large scale lecture is currently an important part of the net-based learning efforts at LTU; not because it is the best form of education, but perhaps because it is most similar to ordinary education.

To conduct a distributed lecture the lecturer prepares HTML slides before the lecture, where additional content can be linked into the slides for in-depth information. The slides is then put on the WWW in advance of the lecture which give ambitious students the possiblility to prepare for the lecture. They can also be used after the lecture for repetition or further in-depth study.

The lecture hall is equipped with computers, cameras, microphones and projectors. This enables projection of the HTML slides in the lecture hall as well as distribution of the slides to remote students attending from the net. In addition audio and video are distributed from the lecture hall, which gives the remote students an equal opportunity to take an active part in the lecture. The remote students can also send audio and video, which gives them the possibility to ask voice questions just as if they were in the lecture hall.

All-in-all the learning experience come near to something that is *better-than-being-there*. That is, the remotely attending student has an enhanced learning experience in comparison to the normally attending student. The remote student can in parallell to the lecture follow in-depth material, have side conversations with fellow students, and can even do secondary low attentive. Furthermore, remote students with disabilities have benefits that are not otherwise available, such as control of the slide presentation format (font sizes, colors etc) and a more undisturbed audio environment.

The mStar environment constitutes a set of tools based on IP-multicast. These tools and their respective use have previously been presented in detail [Parnes 1997a][Parnes et al. 1997b][Synnes et al. 1998], but here is a brief summary of the most used tools:

- mMOD - media-on-demand server for recording and playback of sessions
- Marratech Pro – fully symmetric media client, which consists of two parts:
  - mVideo (audio and video)
  - mViewer (slides, chat, whiteboard and session directory)

The lecturer announces a session for the lecture, then both lecturer and students launches Marratech Pro. All media are then presented locally in the lecture hall as well as distributed to the remotely attending students. The student can ask questions by either sending voice (mVideo), text (mViewer chat) or figures (mViewer whiteboard). Note that the students in the lecture hall can hear and see the remote students and the other way around.

The participants are 'submersed' in a fully symmetric environment that takes distance education a step further from traditional HTML-based courses. The students are no longer passive receivers as they can interact in real-time, which is very important for promoting student participation and debates between class members.

Finally, the lecture can be recorded with mMOD and can then later be played back. A recorded session can for instance be played back into a live lecture, which enable reviewing and debating of related recorded material. The recordings also give students a possibility to rehearse before exams, and – more important – follow courses asynchronously. The latter is a major point for life-long-learning issues, where people that cannot attend during day-time or even follow a course full-time actually can take part of a course.

2.2 Virtual Student Community

The lectures mainly offers a one-to-many channel, since students often are too shy to ask questions – especially if the session is large. We have found that something complementary is needed, where students can cooperate and interact with each other. It is naturally very important, perhaps even vital, for remote students to have a continuous contact with the teachers and fellow students.

Creating such a community, as described in [Lai et al. 1995], can also lessen the workload for both students and teachers. Today students themselves are sources of information, the teachers are no more the sole information source, which means that collaboration and sharing of information is vital to make large distributed courses a success.

However, most of the courses currently given using the mStar environment at LTU are *normal* university courses. This means that the incentive to establish a virtual student community is weak, since there is a physical community to fall back on. It is always possible to knock on the teachers door. The result is also that the current virtual student communities are sparsely populated. This would change if most students were *real* remote students, and the physical community was not available.

2.2.1 Virtual Teachers Room

The virtual teachers room is basically a Marratech Pro session where the teachers of a course are available to answer questions or chair discussions. This could also be a session where a group of teachers are available – thus not necessary linked to a specific group, but as a general resource. The latter case might be important for the feeling of continuity for remote students, since they change courses every tenth week and need a fixed point in their studies.

2.2.2 Virtual Group Room

A Marratech Pro session can be used by a group of students, forming a virtual group room, to discuss course related issues, with or without a teacher attending. The virtual group room can also be used for project status presentations, where a subgroup of a larger class is attending.

This form of meetings may prove invaluable, as remote students need to overcome isolation by forming groups and socialize. It is therefore important that courses emphasize collaborative over individual learning, in order to stimulate use of this media.

2.2.3 Virtual Billboards

The value of asynchronous communication should not be underestimated, as many students choose to follow courses entirely or partly asynchronously. Systems that support asynchronous communication are numerous, ranging from simple mailing lists to advanced WWW-based boardsystems. LTU has recently deployed a system developed internally, W3Cs, which enables students and teachers to communicate via a bulletin board. W3Cs also offer basic support for course management, a task earlier handled by homemade scripts individual to each teacher and course, as well as support for document publication.

One observation made is that usually silent students also contribute to asynchronous communication, maybe because they have more time to formulate their meaning or since the interaction is more abstract. This is more noticeable if a electronic group is maintained over time, creating a virtual community of students where the students *feel like home*. The virtual community must however have an active leadership (introducing new members and excluding misbehaving members) and clearly defined boundaries (limiting what should be discussed).

2.2.4 Lessons Learned

The statistics from our mMOD server logs show that many students prefer to watch lectures during evenings, or even late at night. The possibility to watch recordings is clearly useful for students having overloaded daytime schedules. Using the playback facilities offers another clear advantage; it enables students to take pauses, to either read additionally related information or to consult the course literature. Unfortunately, these students can not be part of the spontaneous discussions during lectures. Having multiple participants active in the playback environment might remedy this to an extent, but this is clearly an area to be improved.

We have noticed that other social protocols have been established when using the environment for presentations and education. Foremost are the sub-discussions that take place using the chat tool, where a set of the participants either discuss the presenters material or something completely uncorrelated. This kind of discussions and sharing of information enhances the learning experience, since attending a lecture physically normally disallows side conversation in the audience.

By encouraging the use of different means of communicating electronically, such as email or WWW-based discussion media, we have found that students tend to help each other. This form of social clustering, is most interesting. It lessens the traditional burden of a teacher, where students with additional knowledge often share it with the rest of the class and the teacher. The fact that students are able to share this knowledge with the group is an enormous advantage to more traditional teaching, where students seems to rarely form groups with more than five members.

A downside is that lectures distributed with the mStar environment tend to become more static than classical (i.e. non electronic) lectures. Experienced teachers are most often those who can improvise and dynamically alter the course of a lecture. These teachers usually do not need to prepare presentation material, as their lectures often take the shape of a normal conversation. With mStar, teachers are easily *caught* in the flow of their pre-made electronic material. It is therefore very important to still allow the teacher to improvise, perhaps by making use of an electronic whiteboard or a sketchboard.

3. Net-based Learning for the Next Milenium

The experience gained over the last years allows us to draw conclusions about how a future system for net-based learning could look like. This chapter therefore aims to present our vision and to give initial answers to some of the questions we have found important.

3.1 Questions

Who will the future student be? Students will range from persons reading a single course to persons following a complete fixed program, but the typical student will have a individualized program (where they select course themselves). They may also have varying study paces and learning styles, as well as different needs for learning support. A conclusion is that the future students will be a very inhomogenous group, especially if we take life-long learning into consideration. This means that courses must be modularized to a larger content than today, so that it is easy to customize a course for an indivual depending on the knowledge level of that individual. Required background information and in-depth material should therefore be easily accessible to give individuals an optimal learning experience.

Where and when will the student study? The possibility to study independently of time and geographical location is increasingly important. The idea that a university is for everyone is otherwise hard to attain, atleast in Europe. People that are limited to study on evenings or that is resident far from a university are dependending on this possibility.

Will the university offer social training? The student used to be a passive individual that is fed information; this is something we need to change. The industry needs persons that can communicate easily and work effectively in groups, which means that we need to better prepare the student for the professional life after graduation. The traditional lectures must be complemented by group discussions and projects where students work in groups. Again this might be a European phenomenon, but is generally important. It is naturally extra important for net-based learning scenarios, where the remotely attending students otherwise easily can get socially isolated.

Will there be a local university? The role of the present universities will not change initially, even if much of the competence will reside on the outside. There are however several efforts to create virtual universities, where top competence is gathered to one virtual location. This means that the physical location for studies will be less important in the future, even if it for obvoius reasons always will remain (lab equipment etc). The most extreme is that the university only will be the *quality brand* of an educational program. It might also be so that the currently ongoing competence concentration around cities with universities will slow down, where the less densely populated areas also can take part of higher education and prosper.

3.2 The Vision of the Student Year 2000

Our belief is that students will not be much different than today, but that they will have increased possibilities to take part of university level education. No longer are large geographical distances or time limitations ruling out where and when education can be offered. The student year 2000 can be everything from a full-time student attending lectures physically on the university, to a part-time student following courses from his home at evenings and weekends. It might even be cheap, both from economical and time perspectives. By giving courses for a larger number of students, they will become cheaper per student. Remotely attending students will also need to travel less, which further lowers the cost as well as the time spent. The student in the next millenium will certainly have demands on cost and time efficient education.

By combining large scale distributed lectures with group projects and personal assignments, well balanced distributed courses is attainable. The lectures should contain invited speakers from the industry or other research organisations, to complement the traditional academic content and to better prepare students for what is required after graduation. The group projects leads to early training of social skills, while personal assignments remain important for grading reasons. However, when courses are attended by a large number of students, it will be increasingly important to establish personal tutors or advisors. Personal relations to teachers are important for the overall learning experience, students simply need someone to ask questions.

The future of net-based learning include equal parts of freedom and responsibility. We can clearly see that the old way of spoon-feeding students with information is coming to an end, and a more collaborative shared learning experience is forthgrowing. This however needs students with high self-motivation, discipline and commitment. It also put higher demand on the courses, on content as well as pedagogics. The new net-based courses must apply specially developed content, following the old tracks simply do not work, and new ways of teaching is also required, which emphasize collaborative learning.

4. Summary and Conclusions

This paper describes a novel multimedia environment for net-based learning which tightly integrate the WWW in a close relationship with IP-multicast technologies. The variety of usage experiences and the successful county-wide deployment clearly demonstrates that the mStar environment is scalable from small informal presentations to complete university courses.

We have argued this from a variety of perspectives, all showing that this environment offers extended support for interactivity, better help through the use of a *virtual student community*, as well as on-line availability of all course media. The goal is to create an educational environment that can be qualified as better-than-being-there, bringing everyday situations such as interacting, learning and collaboration to the Internet.

5. Future work

Today the different tools are simple and intuitive to use, and the technology is rapidly becoming stable. There is however a long way to perfection, especially considering the pedagogic aspects. Large scale lectures is still far too common, which in turn are too limited when distributed over the network. Using only HTML slides is too limiting, and using the mouse to draw in the electronic whiteboard is too unprecise. Work is currently proceeding to install a pen-based electronic whiteboard (synchronised with the mViewer Whiteboard) in the lecture hall, to better support spontanity.

Although the remote students have a very good environment for following lectures, the physically attending students have a less than perfect environment. This is due to bad hardware, where the LCD projector available in LTUs lecture hall is both too noicy and weak. Together with limited spontanity, this creates a *tiredsome* setting for the locally attending students. Hopefully new funding can sponsor a better equipped hall.

As a last issue, the general pedagogic and social issues in our net-based learning environment needs to be studied. How good are distributed courses in comparison to traditional courses, and how does the results of remotely and physically attending students compare? Our belief is that we have a strong technology, but that we are weak on pedagogy. Hopefully, the new Center for Net-based Learning at LTU, CNL, will help us bring clarity to the remaining pedagogical issues.

6. References

[Synnes et al. 1998] Synnes, K., Lachapelle, S., Parnes, P., & Schefström, D. (1998). Distributed Education using the mStar Environment. *World Conference on the WWW and Internet (WebNet'99)*. 1998, Orlando, Florida, USA, November 9-12. Rewarded Top Paper. Also published in an extended version at *the Journal of Universal Computer Science*, 1998, Volume 4 / No. 10, Springer Science Online, <URL:http://www.iicm.edu/jucs_4_10/>.

[Perron 1994] Perron, D. (1994). Learning on the WWW: A Case Study. *Second International WWW conference (WWW2)*, 1994, Chicago, USA.

[Goldberg et al. 1995] Goldberg, M., Salari, S., & Swoboda, P. (1995). World Wide Web – Course Tool: An Environment for Building WWW-Based courses. *Fifth International WWW conference (WWW5)*, 1995, Paris, France.

[Ibrahim et al. 1995] Ibrahim, B., & Franklin, S. (1995). Advanced Educational Uses of the World-Wide Web. *Third International WWW conference (WWW3)*, 1995, Darmstadt, Germany.

[Lai et al. 1995] Lai, M., Chen, B., & Yuan, S. (1995). Toward A New Educational Environment. *Fourth International WWW conference (WWW4)*, 1995, Boston, USA.

[Parnes 1997a] Parnes, P. (1997). The mStar Environment: Scalable Distributed Teamwork using IP Multicast. *Licentiate Thesis, Luleå University of Technology*, 1997.

[Parnes et al. 1997b] Parnes, P., Synnes, K., & Schefström, D. (1997). The CDT mStar environment: Scalable Distributed Teamwork in action. *International Conference on Supporting Group Work (Group'97)*, 1997, Phoenix, Arizona, USA, November 16-19.

[Deering 1991] Deering, S.E. (1991). Multicast Routing in a Datagram Internetwork. *PhD Thesis, Stanford University*, December 1991.

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Abstract: In rural states such as Vermont, it is often difficult to find needed resources in a single community. New educational concepts, new technology, and new subject content require collaboration among those who carry some experience in at least one of these new areas. With the advent of the World Wide Web and the recent technological ease of digitizing images, sounds, movement and text, these collaborations can occur at a distance. In 1995 the US Department of Education provided funds to Vermont schools via the WEB Project, http://www.webproject.org, to build an innovative online network of students, teachers, artists, and community organizations working together to help improve student performance in the arts, humanities, and social sciences. Online Arts Mentoring in music composition (Vermont MIDI Project) and visual arts (Art Responding Through Technology - ARTT) formed the first two groups.

High expectations and new standards placed on rural areas with limited resources can stress a system to collapse, or they can provide the conditions needed to spark ingenuity. Arts teachers in Vermont have chosen ingenuity over collapse and throughout the course of the last five years they have built an online system for support of these new standards that remains true to the artistic process and inspires the students, mentors, and teachers who participate. By selecting a few key learning goals in critique, problem solving, communication, and personal development, an online arts mentoring system has been built to address many national and state standards. This paper tells the history of the network's development and shows the importance of technology in meeting those goals.

First Exchanges -- E-Mail and Attached Files

In 1994 the state of Vermont, like many other states, offered monies to schools so that they could build a technological infrastructure and create models for effective distance learning. While most schools were thinking of hubs and routers, a small group of music teachers were worrying about meeting a new standard for music composition. Because few of the group members had ever been taught to compose, they faced many of the same concerns that teachers in other disciplines face: how can I teach something I don't know myself? The distance learning grant provided the initial computers and keyboards necessary to begin an exploration of this question together. With accounts from America Online, teachers sent e-mail and attached MIDI files to each other and to the network coordinator. Like many other early initiatives across the country, there were more discussions about what to do and how to do it than there were actual compositions exchanged. Measurement of success was counted in terms of numbers and types of messages, with an assumption that a reduction in technology related questions and an increase in actual music exchanges would show improvement. Other national projects (quote Judi Harris work) analyzed their beginning exchanges in a similar manner.

During the initial phase of the project, January - June 1995, the only guideline established was that people would send messages. Lots of messages were sent and the quality of student compositions was understandably low, with rare exception.

That the Vermont MIDI Project had begun something cherishable dawned on participants at both ends of a telephone line in 1995. The story below describes this event (MacLeod 1998):

"In the spring of 1995 I waited with a 9 year old student in southeastern Vermont who was sending a composition to students in northwestern Vermont as part of a tech fair demonstration about a new project in MIDI Distance Learning begun the previous January. Will waited patiently while 6 adults tried to restore the school's dial-up connection so that he could mail his music. He paced quietly for the next hour while the students in Essex Junction read and responded to his composition. Will was asking them what worked well and what they thought needed improvement in his piece.

A response from Essex finally came.

Thanks for sending your piece. Good luck at the Tech Fair. A fifth grade class at Founders Memorial School listened and sends you these comments: Erin wants to know if you play the piano. How did you know what notes to choose? Jo liked the way it climbs and falls and likes how the rhythm keeps on rolling.... Joanna thought it was very creative it had a good beat and interesting notes... Lindsey wonders if it is finished because it doesn't sound like the end. She sang a pattern that would sound good as an ending....

Will responded with relief and a wry smile, "How did Lindsey know my piece wasn't finished?? I have been trying really hard to figure out the ending. I tried 10 things that didn't work. I can really use this." He left quite excited that someone he didn't even know had recognized his dilemma. Will wrote back again, asking for Lindsey to send him the patterns that she had made up. Even though he didn't use the exact patterns that Lindsey sent, she had given him the inspiration to finish his composition.

Beginning a Structure

An unstructured exchange continued until winter of 1996 when the network participants gathered in person for a meeting to discuss what was working and what needed improvement. Student enthusiasm for music composition using MIDI tools boosted the desire to continue the network. High on the list of priorities for improvement, however, was the demand for consistency in level of response (participants who were spending time giving detailed feedback to students in other schools were getting their feelings hurt when they received cursory response to their own work) and a request for help in teaching composition. These two desires provided a basis for the original structure of what would become Online Arts Mentoring. Guidelines for feedback were drawn up in the form of a three-point scale for reflection and critique:

Generic Rubric for Assessing Student Responses

Level 3: Accurately describes the area being discussed. Gives detailed examples, references, connections or responses to general insights. Uses arts vocabulary.
Level 2: Accurately describes the area being discussed. Uses a mix of arts vocabulary and general terms.
Level 1: Gives general comments that could apply to other situations as well as the one under discussion.

A plan to incorporate artists-in-residence into the network was also designed. A concern on the part of the coordinator that the e-mail exchanges were not resulting in any noticeable improvement to the network as a whole, but seemed isolated to those who were receiving paired responses, was put on hold until the communications technology itself improved.

Formalizing the Structure in an Online Conferencing System

In the spring of 1996, the MIDI network gathered in person once more to discuss whether or not the suggested improvements were taking hold. By this point, teachers realized that the students cared deeply about the compositions and took their e-mail responses seriously, again providing the impetus to continue. Together, they articulated the need for a description of what the students were trying to do and a request for specific types of feedback so that the level of response could be at Level 2 or Level 3 on the scale designed previously.

By this point in time, the World Wide Web was becoming accessible and early Web based conferencing systems were on the market that could be adapted for the MIDI network's purpose with some additional cgi scripting and the development of a relational database. Funding for this particular effort and a broader extension to improve student learning in the Arts, Humanities, and Social Sciences came from the United States Department of Education, Technology Innovation Challenge Grants program with the funding of the WEB Project. Federal funds and a local match gave the system the resources it needed to prototype and develop ideas that were not yet available on the open market, and the WEB Project provided a link to learning in other content areas.

Design specifications were built so that the site would deliver a web-based system that would support the learning goals of the network, provide a system of assessment of the work, and create a database for future analysis.

Support the learning goals

Using a web based conferencing system meant that computerized forms could reinforce three of the emerging network agreements:

1) Describe in detail what you are trying to do.
Rich descriptions help the viewer understand the intent of the creator. It is helpful to know the assignment that the student is working on. Supplying this information gives the responders a context from which to comment. It is also helpful to know the stage of the work such as just getting started, in the process or completed.

2) Request feedback, but be open to more than what is asked for.
Saying what it is that you would like to have input about helps the responder to focus and give comments that are useful. That being,said, a responder may also wish to give comments about some aspect of a piece that have not been specifically requested. High school students, especially,
have asked that mentors use their expertise to help them stretch their imaginations and the possibilities offered.

3) Give specific and detailed comments that are based on helping a person reach his /her intent.
The goal of the online critique process is to develop multiple suggestions for how a student can go further with his or her work. That means that those giving responses need to listen to what is trying to be accomplished rather than responding solely from personal opinions, beliefs, or taste.

These agreements translated into a form with required fields for description of work and requested feedback and provided a link to an upload form for comments. All of the comments could be viewed as running text so that students could easily review the various, and sometimes opposing, ideas of others as they chose to use specific input to refine their compositions.

Provide a system of assessment

The MIDI network had already established a scoring system for levels of response. A third level of password security was built into the web design so that, should the network desire, scorers could assess the level of response of each comment. Allowances were also made to score the compositions themselves, even though a scoring system had yet to be built in 1996. To build in rater reliability, the WWW design called for three scores of a single piece of work. If all three scores agreed, then the file was to be placed into a "scored" archive. If all three scores did not agree, then the file would be placed into a "disputed" category so that agreement could be reached or the filed discarded from analysis as "unscorable."

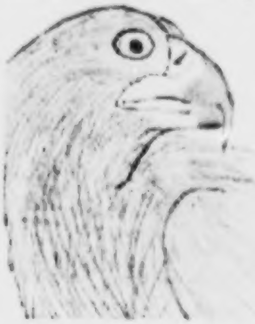
Create a Database for Future Analysis

If the online arts mentoring system remained as dynamic as the initial activity suggested, then it would be important to gather other data during the uploading which could be used later. Fields to measure classroom behavior over time (group work and locus of control), grade level indicators, and location were added to the form. A compromise between amount of data needed for research versus the desire for unobtrusive measurements resulted in the development of radio buttons and pulldown screens for these items. Questionnaires were also developed and the results are stored in an online database. Together with the data from assessment, the information gathered from the site forms and surveys can be used to make direct statements about student learning as a result of the conferencing system. A research project concerning the development of quality in the MIDI Project is currently underway.

Extending the System to Visual Arts

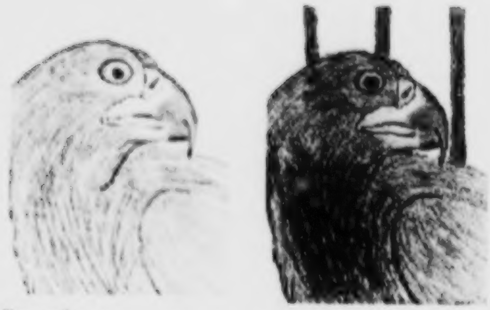
As the music educators and composers showed what was possible when students, artists, and mentors collaborated, their network attracted the attention of art educators who decided to adapt the music composition model to online visual arts in 1997. Thus, another initiative in Online Arts Mentoring was born (Art Responding to Technology -- ARTT), using a similar pattern of reflection and critique of student work-in-progress.

From: Lee
Organization: VT Elementary School
My name is Lee , I am a sixth grade student . I need help on my pencil drawing, I have no clue what I should do next. Do you think you could give me some help? I like this drawing alot.
Requested feedback: What can I do to the background? What should I do with the bird's chest? How can I make the values show more than they do?



Comment Excerpt From: Joan Curtis, Artist
The strength of your picture so far, I believe, is the interesting composition. The way you have arranged the close-up eagle within the picture's edges is quite powerful..... I would like to see a little more description of the feathers you are seeing.... Is it possible to be more specific with your pencil?....

Comment Excerpt From: Ken Leslie, Johnson State College Visual Arts Center
....You asked about "background." This is the place where you can add information that will tell a bit of a story. Imagine how different this same drawing would be if there were tree branches and leaves in the background, or hunters with guns, or zoo cage bars. Not one line of the eagle has changed, yet the meaning of the drawing is completely different for each of those backgrounds....

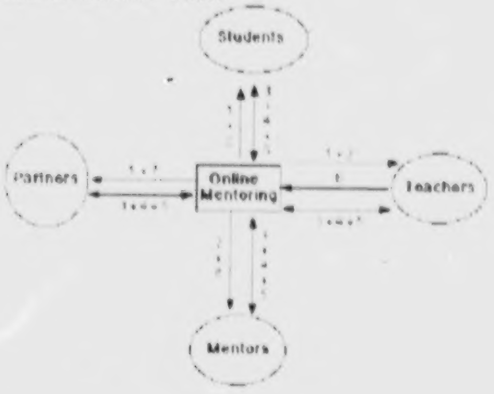


From: Lee
Thank you so much for all of your remarks. What I ended up doing is I put bars in the back so it looks like it is in a cage in the zoo.

Building on Research to Inform Practice

As the Online Arts Mentoring system was being developed, similar trials were occurring across the United States in other content areas, some of which were based on dialog as well. A literature search (Sherry in press) reveals that this process follows closely what Jenlink and Carr (1996) name "design conversations" and that the processes used to organically develop the online learning community embody the qualities of active learning articulated by the REAL Project (Rich Environments for Active Learning), especially that of cognitive apprenticeship (Grabinger 1996). A WEB Project survey taken in 1998 confirms that the Online Arts Mentoring system cultivates an environment where all participants are learning from the experience.

Mutual Benefits Chart



1. **Improving their work**
2. **Getting affirmation**
3. **Seeing range of examples**
4 **giving critical feedback**
5. **Learning to use technology**
6. **Giving curriculum examples**
7. **Better understanding the educational system**
8. **Learning more about students**

Teacher researchers have been developing systems to decrease the learning time that has been involved in addressing new standards, higher expectations, and the use of telecommunications to improve student learning. Through a University of Vermont course on Action Research, the current MIDI coordinator has designed a professional development process for music (MacLeod et. al 1998) which has also been transferred to the visual arts

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(Tavalin et. al 1999). The characteristics of these processes include a mix which balances skill development, critical input on work in progress, and a learning environment in which all participants contribute and learn from each other.

Looking Toward the Future

With the advent of Online Arts Mentoring, Vermont's teachers and students are given a portal through which they find access not only to each other, but to working artists and community arts organizations where professional collaborations and even personal friendships can blossom and grown. The use of asynchronous threaded discussions for critique of student work online has provided teachers with a resource that is there when they need it, while community organizations and mentors, http://www.vaae.org/studios.html, have gained contact with young artists starting their explorations of the field, and access to new technologies which would have been out of reach financially for them to invest in individually. During the 1999 spring gathering, network participants listed what is currently working well in the Online Arts Mentoring and what needs improvement.

What is working:

- A developing sense of community among the teachers, students and artists/mentors
- A high level of enthusiasm amongst students
- A high level of exchanges about the postings. Students increasingly use arts vocabulary with precision to communicate abstract ideas
- Behind-the-scenes and online discussions about possibilities, planning, actions, problems
- System addresses creation as a process: 'The creative process,' rather than creation as an event

What needs improvement:

- A commitment that students reply once they have received comments
- Increased feedback to mentors about the usefulness of their comments
- A method for better management of time
- Increased participation of pre-service teachers

Having begun as an innovation, Online Arts Mentoring is entering a phase of institutional adoption, with agency sponsorship from the Vermont Arts Council which should lead to long term sustainability. As the process of online mentoring evolves and new members are introduced, it remains essential that they continue the conversation about what is working, how well it is working, and how to improve.

References

Grabinger, R.S. (1996). Rich environments for active learning. In D.H. Jonassen, ed. Handbook of research for educational communications and technology, 665-692. New York: Simon & Shuster.

Jenlink, P., & Carr, A.A. (1996 January-February). Conversation as a medium for change in education. *Educational Technology*, 31-38.

MacLeod, S., et al. (1998) *Composing in the classroom: Music, MIDI, and the Web.* Available: Sandi MacLeod, Vermont MIDI Project, 9-30 Steeplebush Road, Essex Junction,VT 05452.

Tavalin, F., et al. (1999) *Art: Responding through technology.* Available: The WEB Project, 58 Barre Street, Montpelier,VT 05602.

Sherry, L. (1999, in press). The nature and purpose of online discourse. To appear in *International Journal of Educational Telecommunications.* Charlottesville, VA: AACE.

Wilson, Brent (1998). Creating technology supported learning communities. In David H. Jonassen, Kyle C. Peck, and Brent Wilson, *Learning with technology in the classroom: A constructivist perspective.* New York:Merrill/Prentice-Hall (forthcoming). Online version www.cudenver.edu/~bwilson/learncomm.html.

Taking a Stand in Cyberspace

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Abstract: Using the example of Taking a Stand in Cyberspace, we articulate issues confronting school, community, and higher education groups as they create online discussions geared to deepen the level of student discourse about literature. Through a collaboration between the Vermont Center for the Book, the WEB Project, and six Vermont schools, students read and discussed three books while teachers maintained an online discussion about the student conversations and the degree to which the student discussions showed evidence of reaching selected learning goals. The experiences resulting from Taking a Stand, along with earlier initiatives, indicate that an evaluation of the opportunity to use and exhibit critical reading skills is as crucial to the improvement of student learning as an assessment of an individual student's attainment.

Introduction

In schools throughout Vermont, educators are faced with the enormous challenge of helping all students move well beyond basic reading skills towards deeper understanding, critical analysis and interpretation of text. Building on the research and lessons learned through online art exchanges among students, teachers and professional artist mentors, The Vermont Center for the Book and The Web Project sponsored Taking a Stand, (http://www.vermontbook.org) an online book discussion series among middle school students from six Vermont schools. Students read and discussed, in class and online, three novels dealing with young people who intentionally or inadvertently take a stand on an issue.

To establish a common focus and address previously identified concerns about reading comprehension, three standards from the Vermont Framework were selected: 1. Students read for meaning, demonstrating both an initial understanding and personal response to what is read; 2. Students make informed decisions; 3. Students respond to literary text and public documents using interpretive, critical, and evaluative processes. Generic scoring systems, keyed to state evidence for these standards, were provided as guidelines for quality.

To facilitate the educational goals, a web-based conferencing system was carefully selected that supported group collaboration and the easy ability to see discussions in list and running text formats. The software interface was essential to building dialog between participants in that it provided a common, reliable space with access to whole conversations and a robust search engine.

Evolution of the Online Experience – One Classroom View

At Walden School, eighth graders typically spent literacy classes two weeks prior to their time online reading and participating in small-group, Great Books-style discussions, forming and responding to interpretive questions and referring to passages in the text to explain or underscore thoughts, back up opinions, and frame questions. They related issues in the books to their own lives and, in some cases, built background knowledge to gain a greater understanding of the book's context. At the end of that preparatory period, they worked with other students in small groups to select an idea or post a question, based on their class discussions and writing.

As a prelude to their online book discussions, students at the six schools got acquainted through personal introduction threads. This was initially very awkward for Walden students as they sought a way to present themselves in cyberspace to unknown others. This was particularly challenging before students had fully conceptualized the experience of online discussion, confirming what Brent Wilson articulates as he describes some of the dilemmas of engaging students in online learning communities (Wilson 1998). Prior to Taking a Stand, some Walden students had used e-mail, some had done chats, most imagined that communication would be relatively immediate. Few, if any, had experienced asynchronous, threaded discussions and were somewhat taken aback by the time delays. Once students received responses or read other postings, however, their interest and eagerness soared.

Students initially discussed *Nothing But the Truth*. Each school distributed groups of students among three discussion forums so that the volume of responses would be manageable and students would have opportunities to dialogue with small groups of students from each of the other schools. Even with this precautionary organizational structure in place, floods of questions, rudimentary responses, and only occasional examples of complete cycles of dialog characterized the first discussion.

As students reflected on the first book discussion, they recognized the importance of thoughtful responses and sustained dialogue. Informed by their early experiences, many students approached the second book, *Beyond Safe Boundaries*, with greater focus and understanding. These qualitative improvements were also promoted by the students' feelings of indignation and outrage about the injustices experienced by many of the characters in this book about young South Africans taking a stand against apartheid. This helped fuel passion for participating in the discussion as students were personally moved and had a stronger desire to write about the issues raised. A less overwhelming volume of responses online, generally greater focus, and more sustained dialogue resulted.

For the third book, *The Chocolate Wars*, schools were paired for discussions. This restructuring made threads even more manageable, although it left sites more vulnerable to the peculiarities of a single partner-school's computer and Internet access quirks, class trips, and scheduling conflicts. As students participated in their third discussion, incomplete cycles of online communication reduced and students increased their critical responses to other postings. The development of critical response over time stresses the importance of conducting a series of discussions rather than structuring online discussions on a book by book basis.

Results of Teacher Research and Online Discourse

Teacher online discussion remained at a functional level throughout Taking a Stand. Questions such as "How can we structure this experience so that it works well within our disparate classrooms?" took precedence over questions related to student learning. Despite previous experiences with online communication for some Taking a Stand teachers, most students and many teachers operated at the novice level in online discussions. Thus, retrospective written analyses based on transcripts of the three book discussions, a review of RMC Denver evaluation survey results, and an in-person exchange provided greater insights than did online teacher discourse as Taking a Stand progressed.

One university paper (Kruse and Quinn 1999 p.5-7) summarizes the flow of discourse from the classroom vantage:

"Although there are overarching factors affecting the flow of a discussion that are related to students' level of experience, teachers observed some patterns during discussions of each of the three books:

- In class, good level of involvement in early discussions.
- First few days of online discussion seems like a "make or break" time. If students find another student's posting interesting, or if they receive what they consider to be a thoughtful or relevant response, there is motivation to continue.
- Somewhere just past the midway point of a two-week cycle, interest and activity peaked as there was a variety of conversations happening and students chose ones to respond to.
- Often, as discussions just got going, the flow was not as smooth as it might otherwise have been, due to factors such as trips, residencies, illnesses and general scheduling. The flow was then very dependent on the quality and quantity of responses; if there was too much lag time or if responses didn't feel thorough or apropos, students felt frustrated and began to lose interest.
- In some cases participating schools posted and disappeared, leaving students at the other school only able to respond to each other.

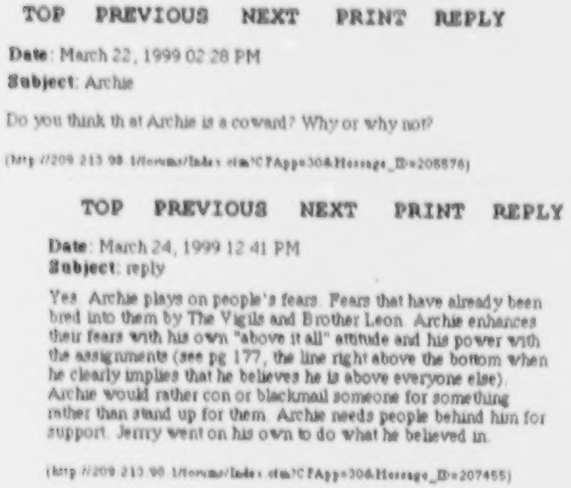
- As the window closed, some discussions had come to a natural conclusion, while others abruptly ended. It would have been possible to continue, but schedules did not seem to coincide and students were then on to the next book. The need for closure became critical; as one student mentioned, 'The ending of some discussions was like falling off a cliff.' "

Relationship between Standards, Assessment and Community Facilitation

Three standards with accompanying generic scoring guides provided a predetermined tool of analysis for student discussions online. An example from "Students make informed decisions" follows:

Level 3: Seeks information and bases decisions on evidence from reliable sources; describes and explains decisions based on evidence; differentiates between decisions based on fact and those based on opinions; recognizes others' points of view and assess decisions from others' perspectives; and analyzes and considers alternative decisions;
Level 2: Seeks information and bases decisions on evidence from reliable sources; describes and explains decisions based on evidence;
Level 1: States opinions and thoughts. Little reference to specific facts.

Scoring student discussions against this rubric showed that the students in the 3 classrooms, which supported an inquiry, based approach from the outset scored consistently at Level 1 or Level 2 while students from the other 3 classrooms scored consistently at Level 1. Growth over time from Level 1 to Level 2 was seen in four of the six participating schools.



Date: March 22, 1999 02:28 PM
Subject: Archie

Do you think th at Archie is a coward? Why or why not?

(http://209.213.90.1/forums/Index.cfm?CFApp=30&Message_ID=208576)

Date: March 24, 1999 12:41 PM
Subject: reply

Yes. Archie plays on people's fears. Fears that have already been bred into them by The Vigils and Brother Leon. Archie enhances their fears with his own "above it all" attitude and his power with the assignments (see pg 177, the line right above the bottom when he clearly implies that he believes he is above everyone else). Archie would rather con or blackmail someone for something rather than stand up for them. Archie needs people behind him for support. Jerry went on his own to do what he believed in.

(http://209.213.90.1/forums/Index.cfm?CFApp=30&Message_ID=207455)

Example of a Level 2 Comment

Scoring of individual posts does not serve as an exclusive indicator that online discussions have been successful. For instance, even though the above example "meets the standard" (Level 2) at an individual level, an examination of the entire thread reveals a single question followed by a single response. Hence, dialog has not occurred. Instead, this online episode mimics a typical "question and test response" approach to reading and discussion.

In reading and reviewing transcripts, it became apparent that genuine discourse unfolded online over a series of postings as students talked their way through an engaging question. Each new entry added evidence that the dialog as a whole was approaching the agreed upon criteria for critical reading. Looking at episodes of dialog

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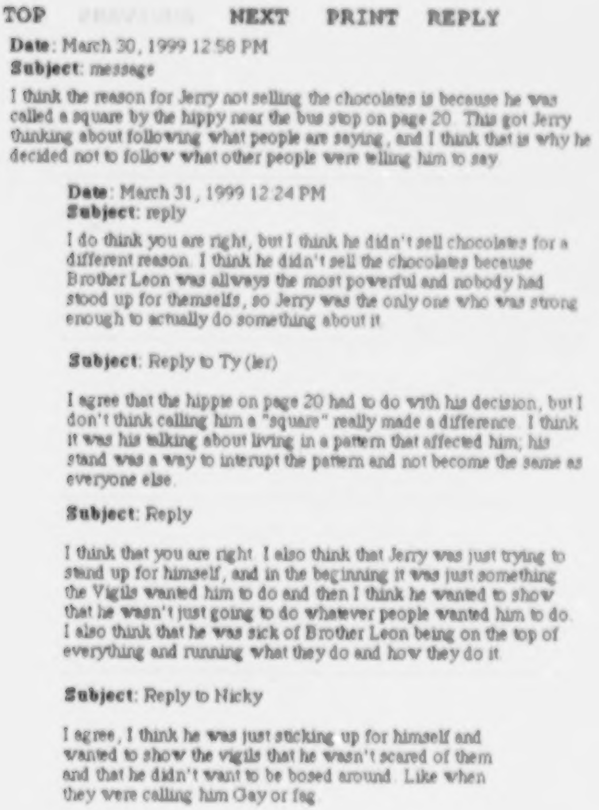
such as the one on the following page reveals that through successive posts, other pieces of evidence from the selected learning goals, such as showing different points of view and multiple interpretations of text, emerge. Moreover, this dialog example comes closer to fulfilling established definitions of learning communities, especially those depicted by Jenlink and Carr as they differentiate between "discussion conversation" and dialogue conversation" and Bereiter who writes about "progressive discourse." (Sherry, in press).

The perspectives of individual performance (single posts) and ensemble activity (dialog episode) provide a system for monitoring a discussion as it progresses so that participants and facilitators can examine whether or not the opportunity to engage in critical conversations about literature has been provided. Then, follow-up presentations or essays can be used to determine if individual students have improved upon their abilities to read critically.

Example of a Dialog Episode



Date: March 30, 1999 12:58 PM
Subject: *message*

I think the reason for Jerry not selling the chocolates is because he was called a square by the hippy near the bus stop on page 20. This got Jerry thinking about following what people are saying, and I think that is why he decided not to follow what other people were telling him to say.

Date: March 31, 1999 12:24 PM
Subject: reply

I do think you are right, but I think he didn't sell chocolates for a different reason. I think he didn't sell the chocolates because Brother Leon was allways the most powerful and nobody had stood up for themselfs, so Jerry was the only one who was strong enough to actually do something about it.

Subject: Reply to Ty(ler)

I agree that the hippie on page 20 had to do with his decision, but I don't think calling him a "square" really made a difference. I think it was his talking about living in a pattern that affected him; his stand was a way to interupt the pattern and not become the same as everyone else.

Subject: Reply

I think that you are right. I also think that Jerry was just trying to stand up for himself, and in the beginning it was just something the Vigils wanted him to do and then I think he wanted to show that he wasn't just going to do whatever people wanted him to do. I also think that he was sick of Brother Leon being on the top of everything and running what they do and how they do it.

Subject: Reply to Nicky

I agree, I think he was just sticking up for himself and wanted to show the vigils that he wasn't scared of them and that he didn't want to be bosed around. Like when they were calling him Gay or fag.

Lessons for Further Improvement

The lessons that emerged from Taking a Stand point toward some simple next steps both for the participating schools and the facilitating community organization. From a teacher's point of view, student individual postings can be monitored through a simple assessment instrument while the co-facilitating organization, in this case Vermont Center for the Book, looks at the overall dialog for opportunities that explicate the learning goals. In order to assess whether or not the opportunity to learn has indeed resulted in actual student learning, essay exams or similar types of traditional assessments can be administered once the online discussions have been finished. To ensure that this cycle leads to the desired results of the network, we emphasize the following lessons:

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1. Begin with common learning goals AND common methods of teaching. Selecting standards is only part of ensuring a common focus; a common approach to teaching is also necessary. In this case, inquiry based learning led to progress toward desired results faster than a traditional "test question/response" approach. Furthermore, an inquiry based approach to discussions is directly aligned with the learning results and assessment systems that have been established by the network.

2. Model the common approach in-person and online. Site analysis reveals that most questions from Taking a Stand fit into the "test question" category, rather than resulting from genuine inquiry. Thus, essential to model for teachers and students what genuine inquiry looks like. Initially, this may take the shape of learned forms of interaction so that students are taught directly how to hold meaningful inquiry.

3. Assess individual and group performance both in-progress and with a final product. In-progess measures include opportunities to learn (monitored by Vermont Center for the Book) and substantive dialog. Specifics of this system are currently under development.

References

Kruse, H., & Quinn, R. (1999). *Online book discussions: Taking a Stand.* Available: Holly Kruse, Cabot School, Box 98, Main Street, Cabot, VT 05647.

Sherry, L. (1999, in press). The nature and purpose of online discourse. To appear in *International Journal of Educational Telecommunications*. Charlottesville, VA: AACE.

Wilson, Brent (1998). Creating technology supported learning communities. In David H. Jonassen, Kyle C. Peck, and Brent Wilson, *Learning with technology in the classroom: A constructivist perspective.* New York:Merrill/Prentice-Hall (forthcoming). Online version www.cudenver.edu/~bwilson/learncomm.html.

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Support for Customization And Personalization On The Web

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Abstract: There is an increasing need in organisations to store, provide and manage information using Internet based information systems. Today's Internet information systems allow easy access to huge amounts of information which are available on the Web. However, existing systems share one drawback: the lack of capabilities that allow users to customize and personalize the systems and their content to their personal needs. This paper presents a metadata based approach for customization and personalization on the Web. The paper starts with an architectural description, which is then followed by a technical design on which the current prototype implementation is based. The functionality of the prototype is presented by several examples.

1. Introduction

There is an increasing need in organisations to store, provide and manage information using Internet based information systems. Catalogs are an effective means to support users in accessing information made available by such systems. Traditional cataloging schemes, such as USMarc (US version of machine readable cataloging) are extensively developed. They provide a large number of different metadata (i.e. data about data) fields for sufficiently describing information resources. In addition, there are often hundreds of fields which are reserved for user extensions. Due to historical reasons, these metadata schemes are ill equipped to describe resources in all detail (e.g., down to the article level in journals). One solution to overcome this drawback is to add new appropriate fields to the original ones. This however affects the standardized metadata schemes and compliance between different catalog systems cannot be guaranteed any more. Another solution is to provide customization of the cataloging schemes without affecting the original scheme. As a result, information resources recorded in catalog systems can be accessed using personalised descriptions. This in turn makes it more attractive for users to work with such personalized and customized systems.

The importance of user customization capabilities has often been noted in the literature. Nürnberg et. al. identify the need to allow easy personalization of the information accessed by web client applications [Nürnberg et. al. 1995]. Additionally they point out that the new digital processes that will characterize future information systems will require customization support. Marshall notes the importance of supporting personal annotations in the digital library [Marshall 1997]. According to Roescheisen, value can be added to an information space through the process of personalization [Roescheisen et. al. 1995].

Important though it may be, the user customization and personalization process is currently not well supported for Internet based information resources. In the development of most systems that are currently used to serve and access information on the Internet, emphasis has primarily been placed on providing access to information. The very limited or non existent personalization capabilities of existing systems is not entirely surprising or unexpected. The Internet presents a difficult environment in which to support the information customization process. Most systems that are accessible over the Internet typically have a very large if not unlimited user base, a characteristic that compounds the difficult issues associated with supporting object customization. Also, many of these systems provide access to information without charge. Overall, the developers of these systems have had limited incentive and resources to support the user personalization of data items. This paper presents a metadata based approach to support customization and personalization on the Web. To do that, the remainder of the paper is structured as follows:

Section 2 describes a metadata approach for supporting customization. The next section then presents a software architecture based on the approach and the current prototype implementation. Section 4 examines related literature and the paper closes in Section 5 with a brief look at future work.

2. An Architecture for Customization and Personalization on the Web

The primary characteristic of the approach described in this paper for supporting the customization and personalization process is that it is metadata based. The use of metadata to support customization was motivated by one its primary characteristics: the ability of metadata to exist and be maintained completely independent of the data to which it refers [Tochtermann et al. 1997]. For example, consider a digital catalog system. The information described in a digital catalog might exist locally (with respect to the catalog itself), it could be managed by a remote system of some kind, or indeed it might not even be available in digital form. In any case, it is possible for the descriptions contained in the catalog to be defined and maintained separately from the information they refer to. The approach described here exploits this characteristic of metadata to enable the customization of data objects in a way that places no restrictions on where the objects are stored or by which system they are managed. Similarly, write or update access to the data objects being customized is not assumed or required.

To achieve this, a strategy is employed in which metadata is used to represent the customizations that are made to data objects. However, instead of using metadata in its more traditional role, to create widely applicable or universal descriptions of objects, such as those found in digital catalog systems, it is used to support much finer grained and individualized descriptions of data objects. These adaptations to the conventional use of metadata enable the approach to support the individual user level customization and personalization of an object independent of the object itself.

The central component responsible for supporting customization in the approach described here is the Customization MetaData Manager (CMDM). As illustrated in Figure 1, the CMDM is a server process positioned between an information supplier (on the right) and an information consumer (on the left).

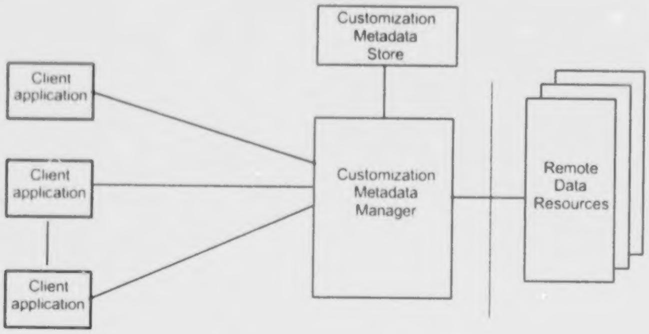

Figure 1: Architecture for metadata based customization

In general, in response to client application requests, the CMDM creates and updates metadata information representing customizations that are made to data objects. The metadata corresponding to data object customizations is maintained by the CMDM in a customization metadata store. Note, however, the customization metadata store does not contain the actual data objects themselves. They continue to be managed by the system where they were originally located ("Remote Data Resources" in Figure 1). Only the metadata information that represents changes that have been made to data objects as part of the customization process are contained in the metadata store. When the CMDM receives a request by an application to retrieve a data object, it first retrieves the data object from the system where it is located; next consults the customization metadata store for any changes that have been defined for the data object; applies any changes that are found; and then returns the data object to the requesting application. More in depth information is provided in [Hicks et al. 1999a].

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3. Description of the PADDLE prototype

The architecture presented in the previous section serves as a basis for our prototype system PADDLE (Personalizable Adaptable Digital Library Environment).

3.1 Technical Implementation

Figure 2 depicts the technical architecture of the current prototype implementation which is based on the architecture presented in the previous section.

The CMDM is based upon Netscape's Fasttrack Web server and provides a Java Servelt [Servlet, 1999]. For each client the Servlet initializes a CMDM request processor which handles all requests coming from the respective client. For example, this includes the coordination of all processes needed to retrieve data objects from a remote information resource or to connect to the customized metadata store.

One challenge was to keep the system as open as possible to heterogeneous remote data resources while at the same time the same basic functionality should be provided for the communication between the CMDM and the remote data resources. For that reason the interface between the CMDM request processor and the remote data resource is implemented as an abstract Java class which provides the basic communication functionality (e.g. abstract methods for retrieving data objects). This interface can be instantiated according to the remote data resource to be connected to the CMDM. An instantiation of the interface defines via which protocol the remote data resource and the CMDM request processor communicate with each other. In addition, it can also implement further functionality which is specific to the respective remote data source. For example, Figure 2 shows two instantiations "Instance1" and "Instance2" using the RMI and the FTP protocol, respectively.

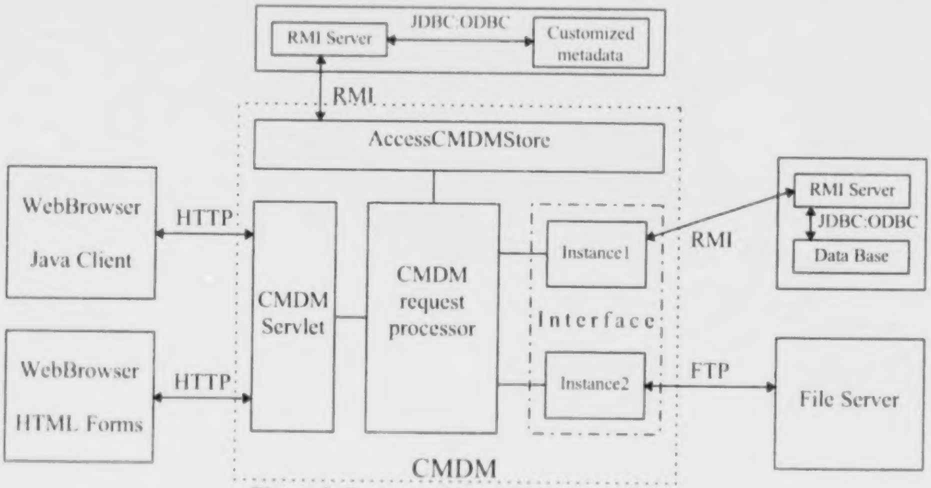


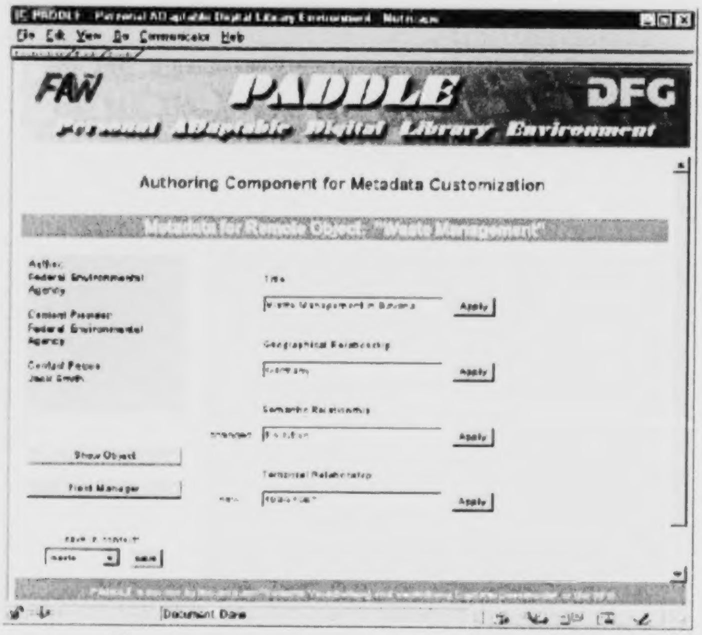
Figure 2: System architecture of the prototype

In the current prototype an exemplary remote data resource is provided by a Microsoft Access database. This database contains about 2000 documents and about 40 descriptive metadata fields for each of the documents. The customized metadata are stored in the CMDM store which comprises a Microsoft Access database for the storage of the customized metadata and an RMI server (remote method invocation) for communication purposes with the CMDM request processor. The communication between the RMI server [RMI, 1999] and the database for the customized metadata is based on SUN's JDBC-ODBC bridge which translates JDBC commands [JDBC, 1999] into ODBC commands. It is worth mentioning that with the JDBC-ODBC bridge it is only possible to run the CMDM request processor and the CMDM store on the same machine. To overcome this restriction and to better support a distributed digital library environment, we decided to use the RMI server as part of the CMDM store. With this infrastructure the communication between the CMDM request processor and the CMDM store is as follows: The CMDM request processor always communicates directly with the RMI server. The RMI server translates all requests coming from the CMDM request processor to JDBC/ODBC commands and sends these commands to the customized metadata base. Results from this database are returned to the RMI server using the JDBC-ODBC bridge.

3.2 Current Prototype

The implementation has successfully been tested for remote data sources which are stored in an environmental database system. This database contains information which describes the state of the environment in Gemany [Hicks et al., 1999b].

The current prototype provides the following possibilities for customization: (a) add/remove metadata fields, (b) change the value of a metadata field, (c) design search forms according to the customized metadata. The following figure shows the form which is used to change the value of a metadata field. For example, the value of the third field "Semantic Relationship" was personalised which is also indicated by a preceding "changed". The fourth field "Temporal Relationship" was added by a user which is indicated by a preceding "new". In the upper left corner the prototype displays in a grey box those metadata fields which cannot be changed (e.g. the content provider of a remote data resource cannot be changed by individual users.)


File Edit View Go Communicator Help
FAW
PADDLE
DFG
Personal ADaptable Digital Library Environment
Apply
Apply
Apply
Apply
Show Object
Field Manager
Document Done

Authoring Component for Metadata Customization

Metadata for Remote Object: "Waste Management"

Author:
Federal Environmental
Agency

Content Provider:
Federal Environmental
Agency

Contact Person:
Jack Smith

Title

Geographical Relationship

Semantic Relationship

Temporal Relationship

Figure 3: Authoring Component for Customization

Once a user has added new metadata fields he wants to use these fields for his search. This, however, requires that he defines his personal search forms which fit to his personalised metadata.

Figure 4 illustrates on the left the authoring component for the design of a personal search form. At the beginning the user starts with an empty search form. Using the "Add field" button (on the left) a user can add in accordance with his personalised metadata new metadata fields to the search form. To do that, the user simply types in the name of the individual metadata field (e.g. "Temporal Relationship" in figure 4). The search form on the left shows that a user has already added the metadata fields for "Geographical Relationship", "Abstract", "Title", and "Semantic Relationship" to the search form. The screenshot on the right of figure 4 displays the result of the personalization of a search form. For example, one can see the field for "Temporal

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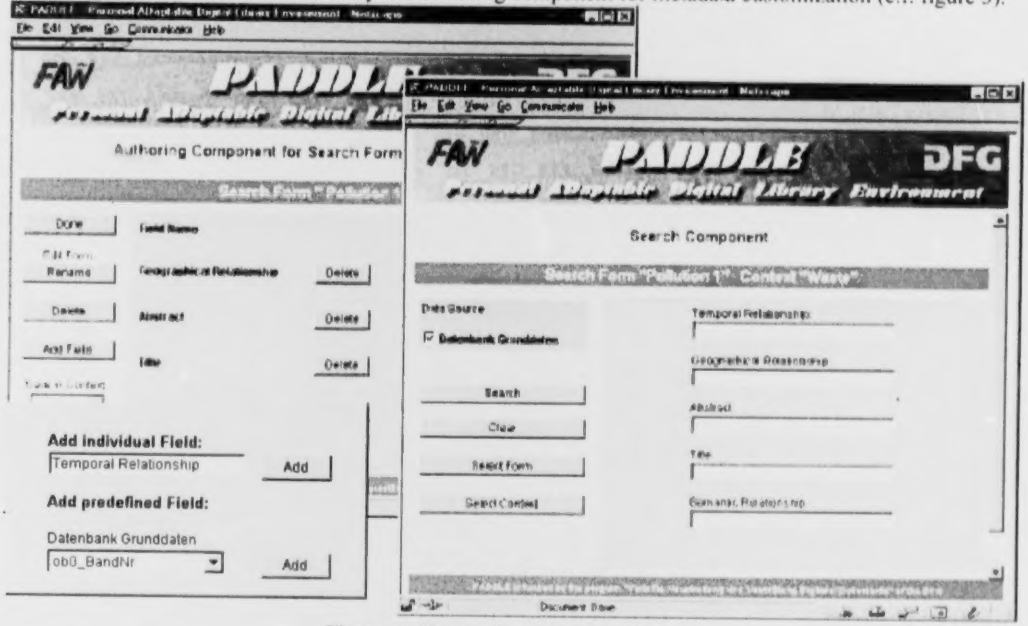
Relationship" was added to allow a search for this field which does not exist in the original metadata scheme but which was added to the metadata by the authoring component for metadata customization (c.f. figure 3).


FAW
PADDLE
DFG
Personal Adaptable Digital Library Environment
Authoring Component for Search Form
Done
Field Names
Rename
Geographical Relationship
Delete
Delete
Abstract
Delete
Add Field
Title
Delete
Search Component
Search Form "Pollution 1" Context "Waste"
Data Source
☑ Datenbank Grunddaten
Search
Clear
Select Form
Select Context
Temporal Relationship
Geographical Relationship
Abstract
Title
Semantic Relationship
Document Done

Add individual Field: Temporal Relationship

Add predefined Field:

Datenbank Grunddaten: ob0_BandNr

Figure 4: Customization of Search Forms

4. Related literature

After the introduction of literature which calls for customization facilities at the beginning of the paper, this section briefly relates our approach to two recently published papers in that area.

In [Schatz 1999] the authors argue that in the 21st century, a billion repositories will be distributed over the world. The difference to the current situation will be that small communities will maintain collections of their own knowledge. Functionality which was first used by professionals will then be used by ordinary, less skilled people. Our approach presented in this paper can be considered as a first step in that direction. Capitalizing on existing catalogued data sources, users will utilize easy-to-use functionalities to adapt the existing repositories to their own needs. Also, with the ability of our approach to easily connect almost arbitrary systems to the CMDM the technical infrastructure exists to build up numbers of independent and small collections which can be maintained by small communities. The Stanford Digital Library Infobus [Paepcke et al. 1999] provides an infrastructure which is similar to the one used in our approach. Similar to the CMDM in our approach, the idea of the Infobus is to pull all components of a distributed digital library together. Library services built into the Infobus provide the necessary support functions, including query translation and metadata facilities. The main difference, however, is that the Infobus models documents stored in the remote data sources as objects while in our approach no abstraction of the original documents exists in the CMDM. Also, the Stanford Digital Library supports hierarchical metadata models while at present our approach allows flat metadata models only.

5. Future work

In future work, we want to investigate how many different and which types of data sources we can support. Our prototype implementation indicates that the approach works well for customizing metadata. A second step will be to apply our customization strategies to the data sources themselves. For example, a customization of a data source could change its layout in the way it is presented to the user. XML appears to be an appropriate

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document description language for this purpose. Currently we have a flat metadata model only, but expect it to be worth exploring how structured metadata models could improve our approach [Paepcke et al. 1999]. Such structured metadata models could allow users to define individual metadata for a group of information sources rather than for single sources as is currently the case. Another important issue is the consistency maintenance that is to keep the CMDM store consistent with the remote data resources. Finally we are thinking about the implementation of the CMDM metadata store using a database, such as Oracle [Oracle 1999], for which JDBC drivers are available. Compared to our implementation the advantage would be that the SQL-Net protocol of Oracle allows direct communication (without an RMI server) between the CMDM metadata store and the CMDM request processor.

6. References

Hicks, D.L., & Tochtermann, K., & Eich, S., & Rose, Th. (1999a). Using Metadata to Support Customization. In Proceedings of the Third IEEE Metadata Conference, Bethesda, Maryland (USA), http://computer.org/conferen/proceed/meta/1999/papers/19/dhicks.html

Hicks, D.L., & Tochtermann, K., & Kussmaul, A., Neils, S. (1999b). Customization in Environmental Information Systems, Proceedings 13th Symposium Computer Science for Environmental Protection, Magdeburg, Metropolis-Verlag Marburg.

JDBC (1999). The JDBC(tm) Universal Data Access API: http://www.javasoft.com/products/jdbc/index.html

Marshall, C. (1997). Annotation: from paper books to the digital library. In Proceedings of ACM Digital Libraries '97. Philadelphia, Pennsylvania, USA. pp. 131-140.

Nürnberg, P.J., & Furuta, R., & Leggett, J.J., & Marshall, C. C., & Shipman, F. M. (1995). Digital Libraries: Issues and Architectures. Proceedings of ACM Digital Libraries '95. Austin, USA, pp. 147-153.

Roescheisen, M., & Winograd, T., & Paepcke, A. (1995). Content ratings and other thirdparty value-added information - defining an enabling platform. D-Lib Magazine. August 1995. http://www.dlib.org/dlib/august95/stanford/08roescheisen.html.

RMI (1999). Remote Method Invocation http://www.tzi.org/~ansu/papers/rmi/PowerPoint/index.htm

Servlet (1999). Web Review - understanding Java Servlets http://webreview.com/wr/pub/97/10/feature/coltron.html

Schatz, B., & Hsinchum, Ch., 1999. Digital Libraries: Technical Advances and Social Impacts; in IEEE Computer, Special Issue "Digital Libraries", Vol. 32, No. 2, pp. 45-50.

Tochtermann, K., & Rickert, W.-F., & Wiest, G., & Seggelke, J., & Mohaupt-Jahr, B., 1997. Using Semantic, Geographical, and Temporal Relationships to Enhance Search and Retrieval in Digital Catalogs; LNCS 1324 Springer, Proceedings of the 1st European Conference on Research and Advanced Technology for Digital Libraries, Pisa, September 1997, pp. 73-86.

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MUM – a Multi-Universe MOO

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Abstract: MUM – a Multi-Universe MOO - is an innovative implementation of object-oriented MUDs, which are becoming popular as a basis of network-based collaborative work, education, and socialization. The paper starts with a brief review of MUD/MOO history, explains the reasons for our interest in MOOs, describes our experience with Jersey - a predecessor of MUM - presents the main features of MUM, explains selected aspects of its design, and outlines our plans for the future.

1. Introduction - history

A MOO is an object-oriented implementation of MUD, which, in turn, is an acronym for Multi-User Dungeons or Multi-User Dialogs. MUDs first appeared about 20 years ago as an Internet-based version of a popular role-playing fantasy game called Dungeons and Dragons. The essence of a MUD is a text-based networked environment representing an emulated world (universe) in which participants can move around (navigate), communicate with one another, create, destroy, pick up and drop simulated objects, use them, and carry them around. From their gaming origins, MUDs evolved into environments supporting socialization and, eventually, education and work [Diversity University, Fitzpatrick, 1996, Harrison, 1996, Journal of MUD Research, Lindstaedt, 1997, Lingua MOO, Mansfield, 1997, Mateas, 1996, O'Day, 1998, Poltrock, 1997, Roseman, 1996, Spellmann, 1997, Steed, 1998, TeamWave].

Currently most popular implementations of MUDs for 'serious mudding' are based on MOOs (MUD Object-Oriented), in particular the LambdaMOO [LambdaMOO] developed by Pavel Curtis and described in [Haynes, 1998]. LambdaMOO includes a special-purpose object-oriented programming language and run-time environment that allows its users to set up a MOO server and create a universe of places and objects with the usual MOO functionality, define a group of users with the authority to modify and extend the universe, and authorize others to use the universe in more or less restrictive ways. Since MOOs can be programmed, they are arbitrarily extendible in two ways: Users can instantiate existing objects and create new classes of objects and functionality.

2. Motivation - the growing interest in MOOs for 'serious mudding'

Our interest in MOOs was stimulated by problems faced by geographically dispersed work teams and the hypothesis that emulated co-location of team members in a virtual space might alleviate this problem. Our initial investigation used Jersey [Tomek, 1998a, Tomek, 1998b], a MOO based on the commercial programming language Smalltalk [Hopkins 1998] rather than Lambda MOO.

Jersey MOO consisted of a Smalltalk server and a web user interface implemented with Java applets. The main window (Figure 1) provided an area for user input, an output area displaying personal communication among the occupants of the user's current location, mouse-click-based access to information about all users and objects in this location, on-line help, and specialized windows for viewing the properties of selected objects and locations, and for interaction with them. The server resided on a remote machine, and network communication between the client and the server was in terms of ASCII text. Client commands to the server had the form of Smalltalk messages. Further details about Jersey are available in [Tomek, Giles 1999].

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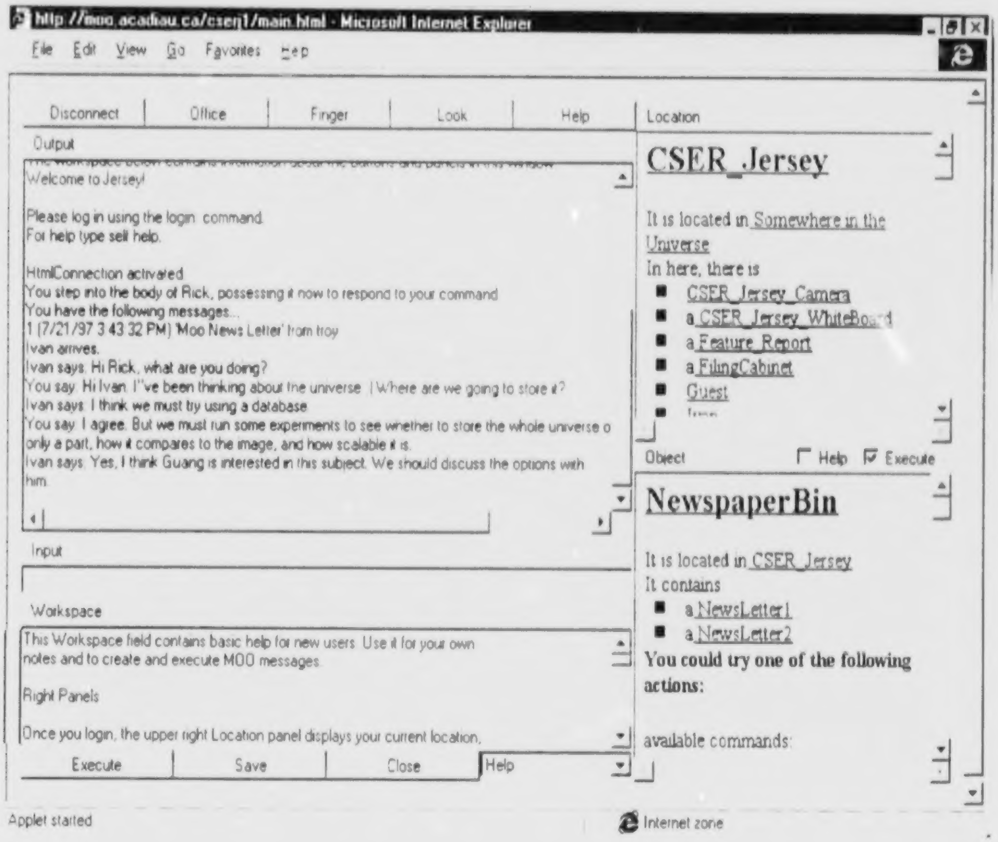

```
Welcome to Jersey!

Please log in using the login  command.
For help type self help.

HtmlConnection activated
You step into the body of Rick, possessing it now to respond to your command
You have the following messages...
1 (7/21/97 3 43 32 PM) 'Moo News Letter' from troy
Ivan arrives.
Ivan says: Hi Rick, what are you doing?
You say: Hi Ivan. I''ve been thinking about the universe. | Where are we going to store it?
Ivan says: I think we must try using a database
You say: I agree. But we must run some experiments to see whether to store the whole universe o
only a part, how it compares to the image, and how scalable it is.
Ivan says: Yes, I think Guang is interested in this subject. We should discuss the options with
him.
```

This Workspace field contains basic help for new users. Use it for your own notes and to create and execute MOO messages.

Right Panels

Once you login, the upper right Location panel displays your current location,

CSER_Jersey

It is located in Somewhere in the Universe

In here, there is

- CSER_Jersey_Camera
- a CSER_Jersey_WhiteBoard
- a Feature_Report
- a FilingCabinet
- Guest

NewspaperBin

It is located in CSER_Jersey

It contains

- a NewsLetter1
- a NewsLetter2

You could try one of the following actions:

available commands:

Figure 1: Jersey's main user interface.

After some experimentation with Jersey, we concluded that its design makes it difficult to implement certain features that we considered essential for collaborative work and education. We thus decided to implement a new MOO from scratch and the result is MUM – a Multi-Universe MOO. In the following section, we summarize the main features of MUM and the rest of the paper details selected aspects of its design and outlines the work that still remains to be done.

3. MUM – a Multi-Universe MOO

On the basis of our Jersey experience, we decided that we need an environment that provides high quality customisable and extendible user interfaces in which the client does as much work as possible to alleviate the load on the server and the network. The environment must also allow easy (preferably automatic) code updating, allow users to register their interest in events occurring in the emulated universe and obtain automatic notification when these events occur, and provide maximum flexibility. Support for features needed for collaborative work and a framework for software agents was considered essential. We also wanted to address the problem expressed in the following statement of Pavel Curtis [Haynes 1998]:

"What would "something better" look like? On the top of my personal list is a vastly more equitable distribution of both power and economics. If online "virtual" communities are to have the same robustness as the more physically oriented ones, they must become pliant and mutable under the same forces that

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cause real-life communities to grow and change. It must be possible for incompatible subcommunities to separate and grow apart, thereby relieving the kinds of stresses that constantly tear at LambdaMOO."

As a result of the above considerations, MUM was designed with a number of unique features including the following:

- A MUM is a combination of a server and a client. Each user can access not only universes running under servers on remote machines, but also create a local universe and allow others to access it.
- The potential multitude of universes is registered in a metaserver. When a user connected to Internet launches MUM, MUM connects to the metaserver, retrieves information about all universes currently connected to it, and allows the user to connect to any one of them (Figure 2).
- MUM is fully event-driven. This means that each object in a MUM universe acts on the basis of events sent to it by other objects, and interaction between MUM objects is restricted to exchanging events.
- All events are 'subscribable'.
- Users can control objects via commands displayed in the user interface.
- Objects only evaluate events from objects that are authorized to send that event to this object.
- Specialized tools and user interfaces are stored in 'tool manuals', objects residing in the universe. A user can download a tool via MUM's main interface. When communication with an object requires a new tool, the tool is automatically downloaded.
- When a user connects to a universe, the server automatically updates his or her code if the user's version is out of date.

MUM is implemented in Smalltalk, allowing very easy modification even at run time.

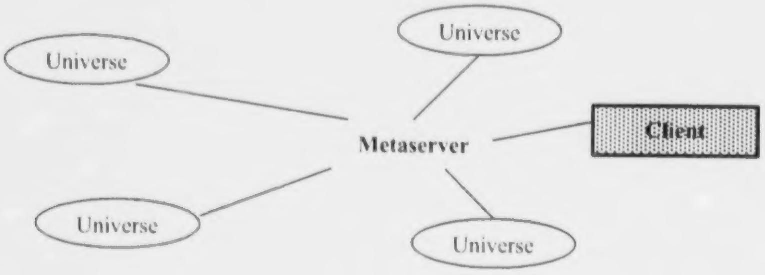


Figure 2: The metaserver provides access to all currently connected universes.

4. MUM Design

In this section, we will explain the principles of selected design features of MUM including MUM objects, events, event handling, and tools.

4.1. Objects, Events, and their Handlers

As mentioned above, all objects in a MUM universe are driven by events. Their classes are subclasses of class EDO (EventDrivenObject), which defines properties shared by all objects such as name, description, location, and owner. Each EDO has its own event handler, its event queue, and a dictionary of events that it understands. Each event has a group of users who are authorized to execute it. Events are instances of an event class, a specialised subclass of MUMEvent.

When an EDO's event queue receives an event, its event handler's process is placed into the queue of active processes and when it gets control, it executes an event in its EDO's event queue. In executing the event, the handler first checks whether the sender is authorised to evaluate this event. If it is, it notifies all registered subscribers, and evaluates the event, typically producing new events and sending them to other EDOs. The details of this process are explained next.

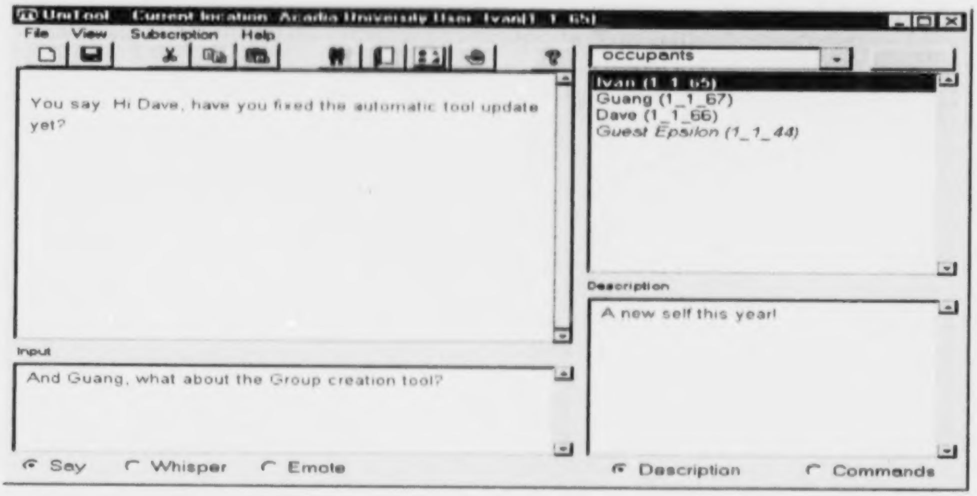
A typical event requires the execution of several steps, each of them calculating a new event and sending it to one or more EDOs. In many cases, an event dispatched to another EDO requests an operation whose execution must be confirmed by the receiver. The eventual confirmation will contain information including the result of the request. Upon dispatching a 'request event', the handler suspends execution of the event in expectance of a confirmation, to resume only after the confirmation is received. In the meantime, the handler passes control to another event handler with waiting events.

For better insight into events and their execution, consider the following example. Assume that a user wants his or her agent (proxy EDO) to move from one room to another. To do this, the agent sends the event 'I want to enter' to the destination room's EDO, requesting a permission to enter. If the room responds with an event granting the permission, the agent may enter and its handler proceeds to execute a certain sequence of states. If the permission is denied, the agent cannot enter and its handler executes a different sequence of actions.

This example shows that whereas the dispatch of some events allows uninterrupted transition to another state, other events require suspension of the event being executed, and its eventual resumption, followed by a selection of one of several possible continuations. As a consequence, the handler must distinguish several kinds of events including request events, confirmation events, and broadcast events. According to this analysis, the object describing the execution of an event – its event descriptor – must allow for branching of state sequences. MUM implements this by describing event execution by a finite state automaton (FSA) whose states describe event-producing blocks of actions, and whose transitions define sequences of states branching at confirmation states.

4. 2. User Interfaces, Tools, and Tool Manuals

If users had to trigger MUM events by typing messages, the environment would not be too attractive. Tools such as the UniTool in Figure 3 are MUM's way to resolve the gap between internal event-based operation and the need for friendly user interfaces. Tools give the user easy to use, extendible, customizable, and downloadable interfaces that hide the internal complexity of event generation and dispatching, and translate events into meaningful information. Using a tool, users send events by operating widgets in the tool's interface.


UniTool Current location Acadia University User Ivan(1_1_65)
File
View
Subscription
Help
occupants
Description
Input

You say Hi Dave, have you fixed the automatic tool update yet?

Ivan (1_1_65)
Guang (1_1_67)
Dave (1_1_66)
Guest Epsilon (1_1_44)

Description: A new self this year!

Input: And Guang, what about the Group creation tool?

● Say ○ Whisper ○ Emote

● Description ○ Commands

Figure 3: Unitool – MUM's universal communication and navigation interface.

Every MUM tool has two parts – a base and the tool UI. The tool UI defines the user interface, responds to user input, and displays output, typically resulting from events coming from the universe. Its interface to the universe works with events and is the base object that accepts messages from the tool, converts them to events, and sends them to the universe on one side, and accepts events from the universe and converts them to tool messages on the other (Figure 4).

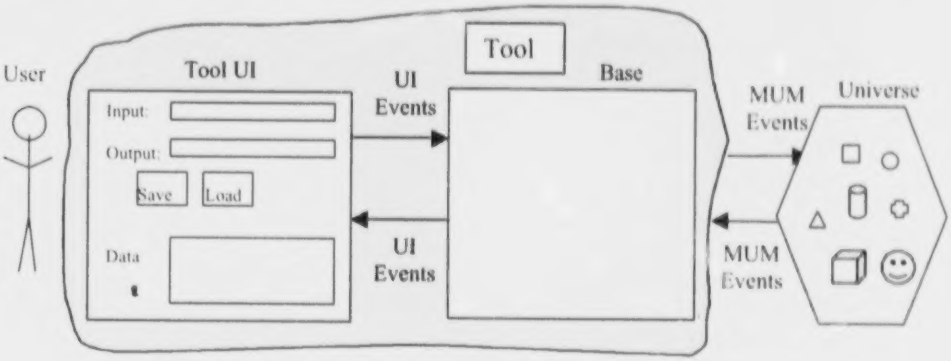


Figure 4: A MUM tool consists of a base and a UI object.

Tool definitions reside in the universe in the form of 'tool manuals'. A tool manual is an EDO containing the definition of the tool interface and its base, the name of the tool, and other information. It includes a vocabulary that can be used to 'catch' the agent EDO to understand messages coming from the universe on the server side to the tool on the client side in one direction, and messages going from the tool to the universe in the opposite direction.

As mentioned earlier, a tool can be loaded dynamically when the user needs it. This is made possible by the tool manual. Although several essential tools are automatically loaded when the user connects to the Universe, others are not loaded until they are needed to interact with a specified EDO, or requested by the user. When a tool is requested, the updating of the client and the agent and the installation of the tool are automatic.

5. Conclusions and Future Work

We described an alternative type of an event-based virtual environment based on the MOO concept and outlined some features of its design. Its main innovative features include a shift of processing from the server to the client to minimize the load on the network and the server processor, a much greater emphasis on comfortable and customizable user interfaces, simple downloading of tools from the sever, automatic downloading of software updates, full reliance on subscribable events and automatic event notification, possibility of multiple servers and universes hosted by the same machine that hosts the client, and management of multiple universes by a metaserver. We discussed at some length selected aspects of MUM's design, focusing on the implementation of events and their handling. We explained why a finite state automaton is used as a model of flexible execution of the required variety of events.

At the time of writing, MUM consists of a working framework and essential functionality but the number of available MUM objects and tools is still limited. Our future goals are to test the performance and stability of MUM with a larger number of users, add or extend CSCW features such as groups, roles, and policies, add numerous MUM objects and tools for general use and for the support of MUM developers, design and implement a framework for software agents, improve support for inter-universe navigation, implement security features, and provide interoperability with external tools. We plan to add CSCW features at a later date.

The task of developing a large library of object types is enormous, and to accomplish it, we will share the software with the general public as soon as it reaches the required level of completion and performance.

6. References

[Diversity University] Diversity University, http://www.du.org
[Fitzpatrick, et al. 1996] Fitzpatrick, G., et al. (1996). Physical spaces, virtual places and social worlds: A study of work in the virtual, In *Proceedings of CSCW"96*: 334-343.
[Harrison, Dourish 1996] Harrison, S., Dourish, P. (1996). Re-Place-ing Space: The roles of place and space in collaborative systems, In *Proceedings of CSCW"96*: 67-76.
[Haynes, Holmevik, 1998] Haynes, C., Holmevik, J. R.(1998). *High wired: On the design, use, and theory of educational MOOs*, University of Michigan Press.
[Hopkins, Horan 1998] Hopkins T., Horan B. (1998). *Smalltalk: An Introduction to Application Development Using VisualWorks*, MacGraw-Hill.
[Journal of MUD Research] *Journal of MUD Research*, http://journal.tinymush.org/~jomr/
[LambdaMOO] LambdaMOO Source code, http://www.moo.mud.org
[Lindstaed, Schneider 1997] Lindstaed, S., Schneider, K. (1997). Bridging the gap between face-to-face communication and long-term collaboration; *Group'97*, In ACM SIGGROUP: 331-340.
[Lingua MOO] Lingua MOO, University of Texas, Dallas; http://lingua.utdallas.edu/
[ObjectShare] ObjectShare. http://www.objectshare.com/.
[Mansfield, et al. 1997] Mansfield, T., et al. (1997). Evolving Orbit: a progress report on building locales; *Group'97*, In ACM SIGGROUP: 241-250.
[Mateas, Lewis 1996] Mateas, M., Lewis S. (1996). A MOO-Based Virtual Training Environment, In Journal of Computer-Mediated Communication, vol.2, issue 3. http://www.ascusc.org/jcmc/index.html.
[O'Day, et al. 1998] O'Day, V., et al. (1998). Moving Practice: From Classrooms to MOO Rooms. In The Journal of Collaborative Computing, Volume 7, Issue 1/2, *The Journal of Collaborative Computing*. http://hermes.chaphall.co.uk/cc.html.
[Poltrock, Engelbeck 1997] Poltrock, S.E., G. Engelbeck, G. (1997). Requirements for a virtual collocation environment. In *Group'97* ACM SIGGROUP: 61-70.
[Roseman, Greenberg 1996] Roseman, Greenberg, M., S. TeamRooms (1996). Network places for collaboration. In *Proceedings of CSCW"96*: 325-333.
[Spellman, et al. 1997] Spellman, P., et al. (1997). Collaborative virtual workspace. In *Group'97* ACM SIGGROUP: 197-203.
[Steed, Tromp 1998] Steed, A., Tromp, J. (1998). Experiences with the evaluation of CVE applications. In *Proceedings of CVE '98*: 123-132.
[TeamWave] TeamWave, http://www.teamwave.com/
[Tollmar, et al. 1996] Tollmar, K., et al. (1996). Supporting social awareness @ work, design and experience. In *Proceedings of CSCW"96*: 298-307.
[Tomek, Nicholl, Giles 1998a] Tomek, I., Nicholl, R., Giles R. (1998). Supporting Software Development Teams. In *Proceedings of Advances in Concurrent Engineering*: 329-335.
[Tomek, et al. 1998] Tomek, I., Nicholl, R., Giles R., Saulnier, T., Zwicker J. (1998b). A Virtual Environment Supporting Software Developers. In *Proceedings of CVE '98*: 67-72.
[Tomek, Giles 1999] Tomek, I., Giles R. 1999). Virtual Environments for Work, Study, and Leisure, *Journal of Virtual Reality*, to be published.

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Indexing and Metatag Schemes for Web-based Information Retrieval

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Abstract: Web-based searches typically result in lower precision than with other document retrieval systems. A major contributor to low precision is limited technology for generating detailed document and content descriptions such as those associated with bibliographic databases. The result is ineffective indexing of Web pages. This paper reviews indexing theory and suggests that authors can contribute significantly to improving retrieval by applying basic indexing criteria. The Dublin Core Meta Data set and XML are seen as a means for implementing indexing theory for web-based documents. A project using the Dublin Core in support of a university class is presented.

1. Introduction

Ideally, when searching for information, one should have access to the world's information resources. Traditional indexing and classification systems have done a reasonably good job of providing access to the bibliographic universe. In today's world, convenience dictates use of information retrieval tools. As a result, traditional retrieval systems are often overlooked in preference for the World Wide Web. Estimates indicate that over 95 percent of all published materials are not accessible through the Web. In addition to not having access to the bibliographic universe, Web searches result in significantly lower Precision and Recall. [Torok & West, 1999] Precision is a standard measure that provides a percentage estimate of the number of relevant items retrieved out of all items retrieved. Recall is the percentage estimate of all relevant items retrieved out of all relevant items in a database. These measures reflect the relevance judgments associated with document retrieval. Although a number of factors contribute to low Web-based retrieval performance, the most significant ones are those resulting from inadequate indexing. The literature tends to focus on the limitations of search engine indexing. Search engines can do little more than index what publishers make available. Retrieval problems stem from authors' lack of indexing knowledge and limitations in HTML for describing document format. For example, many Web page authors do not utilize meta tags or utilize them inappropriately. Web document descriptions are limited to the URL, title field, hyperlinks and broad attributes such as graphics. These makes content and field indexing difficult. Essentially, few Web-based devices exist for maximizing Precision and Recall. Hyperlinks are one of the few such devices available, but these are generally sporadically assigned. Web publishers should have the responsibility of preparing publications in a way that facilitates retrieval. Understanding basic indexing principles can help. Following this line of argument, let us briefly examine basic indexing principles.

2. Indexing Theory

Essentially, indexing and searching are all about finding the right words. In retrieving an item, something about it should indicate how it relates to the query. The idea is to match the words in a user's mind with those used in a document. Unfortunately, the words don't always mean the same thing. Vocabulary control or the lack of it, creates one of the biggest problems in finding desired documents, or avoiding the retrieval of unwanted documents. This can range from simply not knowing which words to use, to variant meanings associated with a word. The concept-mapping feature of search engines is sufficient to cluster related documents, but do not allow for vocabulary control. The responsibility of providing the "right" words rests with both the searcher and the document author. Indexes provide a critical link between the information need and relevant documents.

When searching for information, users are directed to the index. Most indexes are inverted, meaning that the index displays a term and provides a reference which point back to the source document or documents, which contain that word. Indexes can also contain a variety of syntactic and semantic devices that identify the role of a word in context, or link a subject to other relevant concepts. The purpose of a good index is to retrieve relevant items from a set of related items, and to minimize the retrieval of unimportant items.

3. Indexing Practice

Indexing practices and tools are designed to maximize Precision and Recall. For example, the traditional "see" cross-reference is a Recall device. Link and role indicators are Recall and Precision devices respectively. Other devices include various types of cross-references, scope notes, parenthetical expressions, term weighting and authority control. Thesauri are the principal tools for authority control. Indexes must be constructed to truly reflect content, and to accommodate the mind frame of a wide range of information seekers. The document producer must also share in the responsibility of providing appropriate terms. A document should accurately convey the intended meaning, and provide searchable field tags to discriminate between document components.

There are three main types of indexes. These are:

- Pre-coordinate indexes (classification schemes, such as Library of Congress)
- Post-coordinate indexes (standard computer retrieval)
- Some variant flavor of both (faceted classification, human indexer selection)

Classification schemes reflect the relevance judgment of subject experts in assigning documents to major subject categories. Most classification schemes are hierarchical arrangements, with more specific classes falling under broader ones. Yahoo, Alta Vista and numerous other search engine providers, use this system. The problem with pre-coordinate schemes is that it is difficult to ascertain in advance what prompts a relevance judgment from a user. Thus, the danger in pre-coordinate schemes is that relevant information may not be classified to suit individual needs. Also, coverage of the knowledge universe is limited drastically by the number of human indexers. The obvious answer is to provide an *ad hoc* classification, determined by an individual's information need. This is the basis of post-coordinate schemes. Essentially, if a user's query can be thought of as a classification, all documents meeting the query parameters fall into that class for that given search. Computer searching provides a post-coordinate type of classification. It is made possible by search engines, which index every word in a Web site. Some search engines utilize stop word lists as an attempt at vocabulary control. Most Web search providers use a combination of pre and post coordinate indexing. For the most part, search engine indexing devices favor increasing Recall, but at the expense of lowering Precision. In order to achieve a balance, indexers need to consider basic design criteria.

4. Design Features of Indexes

Four major design criteria govern a good index:

- **A** accuracy
- **C** consistency
- **E** exhaustively, and
- **S** specificity

Good indexes are accurate. They contain no errors, such as typos, blind cross-references or ambiguities. At the very least, it should be easy to ascertain that a subject or concept is present. Accuracy may also reflect the ability to show relationships across word variants, automatically up posting to spelling variations, being mindful of case sensitivity, and being able to distinguish between proper and common terms. Accuracy may also have to do with keeping an index up-to-date.

Consistency refers to the consistent application of indexing rules. In human indexing we talk about inter and intra indexing consistency. That is, does a given indexer always index the same across documents, or would all indexers index a given document the same. In machine indexing, intra-indexing consistency is usually not a problem although a searcher may have difficulty ascertaining how the indexing actually occurs. Inter indexing across search engines is a real problem, particularly between directory and keyword search engines.

Exhaustivity refers to how completely a document is actually indexed. Some search engines index only portions of a document. Simple frequency counts of term occurrence are not sufficient to justify indexing. The more index terms posted to a document, the higher the Recall. However, exhaustive indexing can lower Precision. Document type and other elements are needed to be truly exhaustive. Exhaustivity also relates to the extent that document are retrieved from a universe.

Specificity involves the level at which an index entry describes document content. If a document deals with cocker spaniels, it should not be indexed under dogs. If the document is also indexed under the subject heading of dogs and related synonyms, links should indicate that the document deals with a particular breed of dog. Semantic differences should be preserved. Essentially, documents should be indexed at the level they present a subject, but should reflect synonymous relationships. Concept indexing practices need to pay more attention to this criterion. Let us turn our attention to things an author can do that facilitate retrieval.

5. Web-based Indexing

To facilitate derivative indexing, document producers should use great care in selecting appropriate terminology to reflect meaning. Documents should begin with informative titles, the use of headings and sub-headings, and structured paragraphs. Documentation should include things like author, date of publication, source, and last revision. These fields are not always searchable in a document, nor is the content amiable to retrieval from different disciplines. Multimedia formats are especially difficult to index. In addition to tagging "free" text document fields, externally derived terms may be added to facilitate retrieval. In modern parlance, this is called "meta data" or meta information".

Meta tags provide a convenient way for document indexing. One author describes meta tags "as attaching a label to an object, such as a can of peas or a package of light bulbs. The label provides information about the contents of the container without actually having to open the container. [http:/www.imsproject.org/metadata] Meta tags are organized into categories, or fields. Each field represents some characteristic of the document or the contents. Meta tags go in the HEAD section of the HTML document, generally after the TITLE tags. They are sometimes the first section to be indexed by a search engine. The two most important Meta tags are those describing the document, and words, which have, clear contextual meaning, such as descriptors derived from a controlled vocabulary. Good indexing tools also guard against malpractice designed to retrieve pages with little relevance to the index terms. Meta tagging lacks the sophistication of well-established knowledge classification schemes. Current schemes tend to reflect practice within a particular industry.

6. XML

Two meta tag schemes currently in use are XML and the Dublin Core. Extensible markup Language (XML) was officially adopted as a standard by the World Wide Web Consortium (W3C) in February of 1998. The W3C calls XML a common syntax for expressing structure in data, or structured authoring. Structured data refers to data that is tagged for its content, meaning, or use. [http://builder.cnet.com/Authoring/Xml20/ss01.html] For example, an XML tag could explicitly identify the type of information <BYLINE>, author of a document <AUTHOR>, cost in an inventory list <PRICE>, all the way down to any level of detail <DOGFOODBRAND>.

XML is a web-based scripting language that promises to provide more efficient applications, and increase both Precision and Recall. XML can specifically categorize data within Web pages, word processing documents, e-mail messages and so on using defined dictionaries of specialized grammar called Document Type Definitions (DTD). Specific DTDs are being developed for various applications. For example, the Microsoft Channel Definition Format (CDF) which describes active channel content, and push vendor Marimba's Open Software Description (OSD) which describes software components. XML can act as a Dewey Decimal System for the Internet. XML overcomes the limitations of HTML by explicitly describing document formats and contents. Essentially, XML allows Web publishers to insert meta tags into their pages. Browsers can read the field codes but would not display them. XML meta tags can also permit browsers to manipulate data without going back and forth to the server. By separating structure and content from presentation, XML will especially benefit people who produce documents intended to appear across multiple media. Another potential application will be the rebirth of Push. Push refers to developing individualized profiles and sending relevant information to the desktop when it appears on the Web.

7. Dublin Core Background

Until XML matures, one of the few formalized definitions for the use of meta tags is the Dublin Core Metadata Element Set. [(http://purl.org/dc] Essentially, the Dublin Core consists of core meta tags that provides information about document and document-like objects. Document elements, that is the meta tags, are represented by descriptive names intended to convey a common semantic understanding of the element. A tremendous advantage is that the Dublin Core can be implemented in HTML for a wide variety of documents. Thus in formulating a search, the query could contain a reference to the element and the searcher could more accurately determine document specific information. The Dublin Core is an approximation of what libraries have been doing with bibliographic description, such as MARC. Element descriptions have been developed for 15 categories, including: title, author, subject or keywords, description, publisher, other contributors, date, resource type, format, resource identifier, source, language, relation, coverage, and rights. An example of a meta tag for author might look like: <META NAME="DC.author" CONTENT+"Andrew Torok">

The Dublin Core provides for the concept of links and roles mentioned earlier. Roles can be described using SCHEME qualifiers. In the event there are existing schemes for coding the elements, these are also indicated in the meta tags. An example might by recommended syntax for representing proper names. Schemes would refer to major standards and conventions, such as those emanating from the American National Standards Institute (ANSI) The schemes are referred to by using links to a source such as a URL. The Dublin Core also provides other qualifiers for data description. For example, the SCHEME may refer only to an existing coding system. For specific local information, a TYPE qualifier could be used. A variety of organizations are working on the syntax for the elements, but have not been widely accepted. For example, Educom has created meta tags for educational documents and on-line training courses. [http://www.ott.navy.mil/1_4/adl/educom.htm]

Most current Web authoring tools have no provision for automatically coding for Dublin Core. Thus the meta tags must be keyed in directly. Also, not all search engines recognize the Dublin Core syntax. On the other hand, There are commercial Web page developers who consider the Dublin Core meta tags an integral component of their publications.

8. NIU Dublin Core

The College of Education at Northern Illinois University is experimenting with the Dublin Core set for Web support of a basic education class. The class is a survey of educational practice and pedagogy. Various ASCII and binary coded documents are indexed according to the Dublin core. Publication come from locally generated documents, documents downloaded from the Web, and links to relevant Web sites. Copyright issues notwithstanding, locally generated documents may consist of original material as provided by teachers and students, or various print and electronic publications. A macro using Visual Basic converts Microsoft Word documents and prompts for the Dublin Core Metatags. Publications are made available on the university Web site, and can be accessed from a course Web page.

An ASCI index card is created for binary coded documents. The reflective activities are CGI scripted so students can complete the forms and send them back to the teachers. Access to the documents is made available through a free Sun Microsystems search engine, called SWISH-E, that can recognize the Dublin Core data elements. [HTTP://SUNSITE.BERKELEY.EDU/swish-e/] Actually, SWISH-E can be configured to search various document fields. If desired terms are not found in the meta data, it automatically continues on to find the words in the document body. Index terms are selected from various thesauri and vocabulary lists. Identifiers are also generated from various existing standards. Graduate assistants are typing in the 15 fields

The population served at any given time consists of several hundred students, across several sections. One advantage of using the Dublin core is to set some uniformity across the various sections of the course. This helps the different instructors present information consistently, provides equitable access to resources, and is advantageous for distance education. The general objective is to provide students access to a core set of publications which reflect course objectives and support collaboration. Despite various instructors contributing numerous print and electronic publications, Precision is quite good. The uniform document and content descriptions afforded by the Dublin meta data permit pinpoint Boolean searching.

One of the biggest problems is that the programming and indexing take time. As the document collection grows, another problem will be that documents reflecting a rather narrow subject area may appear redundant. However, the problem should not be as severe as relying totally on broad Web searches. Non-text publications pose a particularly difficult problem as items are scanned in, downloaded from the Web, or input from a digital camera. At this time, the indexing and retrieval seem to work quite well. As external indexing in the form of XML becomes standard, students may well be able to locate relevant publications from the Web. This will allow for greater collaboration with other colleges. This will also lessen the need for faculty-generated selection and acquisition, and more fully support a constructivist environment. As XML document indexing and retrieval mature, the use of Push technology may become a feasible method for maintaining a specialized Web site. A Push model to support college curricula has been described in the literature. [Torok, 1997]

9. Conclusions

In conclusion, there appears to be continued improvements in Web document indexing and the ability of search engines to reflect user vagaries. Ultimately, the goal should be to maintain the freedom of expression characteristically associated with the Internet and the World Wide Web. There should be equal room for scholarly publications, cloaked in their social and political mantras, and figments of the imagination uninhibited by editorial constraints. The objective language of disciplines should not remain a mystery, nor should it give way to meta language purely to suit the needs of those unwilling to pay the price of formal learning. There does not need to be a watering down of academic disciplines and their curricula. If publishers are held to accurately describing the nature of their publications, users will have greater success in identifying relevant publications, or avoiding undesirable ones. Adhering to good indexing practices, and utilizing new technologies such as XML will help.

10. References

Torok, A., & West, J. (1999) The Impact of Information Literacy on Web-Based learning. http://coe.cedu.niu.edu/~torok/aect01.html/ (last visited July 3, 1999)

http://www.imsproject.org/metadata (visited July 3, 1999)

http://builder.cnet.com/Authoring/Xml20/ss01.html (visited July 3, 1999)

http://purl.org/dc (visited July 3, 1999)

http://www.ott.navy.mil/1_4/adl/educom.htm (last visited July 3, 1999)

http://SUNSITE.BERKELEY.EDU/swish-e/ (last visited July 3, 1999)

Torok, A. (1998). Push or Pull: Internet Support for Education. *XIII Congreso Internacional Sobre Tecnologia Y Educacion a Distancia, 1997,*. Universidad Estatal A Distancia, San Jose, Costa Rica. 644-653.

Knowledge Objects and Knowledge Navigation

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Abstract: The production of multimedia computer-based educational materials is time-consuming and expensive. There is a growing need for methodologies which facilitate the efficient production of courseware. One possible approach is to define standards for the representation of knowledge. This paper investigates the design of re-usable educational knowledge objects.

1. Introduction

The creation of more efficient instructional methodologies is always a priority for instructional designers. At the present time the creation of computer-based instructional materials is both time-consuming and costly. In general, each instructional design project is a unique event involving the inextricable linking of content and methods. Since content cannot be separated from methods it cannot be reused or recycled with a new delivery system. Neither can the delivery system easily accommodate new content. Recently there has been interest in AI circles in the production of ontologies, or reusable databases [Gruber, n.d.]. Little has been reported in educational technology on the subject, perhaps because of the lack of a convenient authoring system for true object-oriented applications. However, without some standards concerning the representation of knowledge objects, instructional agents will not be able to manipulate them. In this paper we expand upon this problem.

2. Ontologies and Knowledge Objects

Among AI researchers, an ontology is a specification of a conceptualization [Gruber, n.d.]. The purpose of an ontology is to enable knowledge sharing and reuse. In practical terms this requires that a vocabulary be defined that is consistent (but not complete) with respect to a body of knowledge that allows the exchange of queries and assertions between agents. [Gruber, 1993] describes some principles for the design of knowledge sharing ontologies. He says that an ontology should exhibit the following qualities: clarity, coherence, extendibility, minimal encoding bias, and minimal ontological commitments. Clarity means that a should communicate the meanings of its defined terms. Coherence means that it should allow logical inferences based upon its axioms. Its shared vocabulary should allow the extension of definitions without re-definition of terms. Encoding bias refers to decisions which are made solely because of limitations of the representation system. Finally, minimal ontological commitment means that the system should make as few claims about the world as possible (i.e., should be the weakest possible theory). Because designing an ontology is engineering and not science or philosophy there will inevitably be trade-offs and compromises in its development. The recent announcement of XML, the extensible markup language, may provide a convenient syntax for the creation of exchangeable knowledge objects.

The idea of instructional knowledge objects is not new. This idea has been exploited in the design of the Electronic Trainer developed by David Merrill's group at Utah State University. In the Electronic Trainer, a set of object categories contains information. For example one type of category is an entity and its parts. A procedure is another type of category. Because there are certain standard ways of teaching and testing an entity and its parts or a procedure, the instructional strategies can be built into the authoring system and applied to the

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knowledge objects without any additional authoring. Also different instructional strategies can be applied to the same knowledge objects. For example, a student may learn about the parts of a machine by having them explained one by one. Alternatively, the student can learn by exploring the parts of the machine in an arbitrary order and be taught the name by clicking on the parts. Essentially, Merrill's design follows the traditional computer science strategy of dividing program and data. It acknowledges that there is a limited set of instructional strategies for any kind of knowledge objects and that if the object is described in a sufficiently rigorous way, an appropriate strategy can be applied to the object, and a lesson can be generated automatically.

The advantages of this approach should be obvious. It allows multiple, and perhaps yet unthought of, instructional strategies to be applied to the same objects over and over again. Secondly, the same strategies can be applied to new, yet undescribed, content without any further authoring. In the very inefficient world of computer-based education, Merrill's approach represents significant progress.

3. Logical Databases

Merrill's approach is a good first step, but it has some weaknesses. First, from a programmer's point view it is unfortunate that the knowledge objects do not have a logical status. In other words, inferences (other than those explicitly described and anticipated) cannot be performed. Another problem is that the knowledge objects are not represented hierarchically. Objects cannot contain objects. In the real world, processes may contain procedures which contain concepts which contain entities which have parts and all of these may have relationships to other processes which are themselves the result of procedures. This kind of logical embedding of multiple objects is not possible in Merrill's programs. However, with XML such embedding is specifically anticipated.

4. Design Parameters for Knowledge Objects

What is needed for the design of instructional knowledge objects is a set of concepts in relationships that can be combined in certain regular ways to describe a set of knowledge sufficiently rigorously that an instructional discourse engine can act upon it, in other words, commit to it. In a sense, what we need is a grammar of knowledge that can represent any and all objects and relations that we might want to teach. Such objects could be shared and reused by instructional designers throughout the world and could be acted upon by an instructional browser provided that the objects were tagged according to a standard markup language. At the current time such a markup grammar does not exist but it is the purpose of this paper to describe what kinds of objects should be represented and how those objects should be joined in hierarchical structures.

First we need to define some of the primitives which would be structured by our grammar. As a simple example we can imagine that the most basic instructional objects would be concepts, procedures, processes, entities, relationships, and histories. Each of these objects would have, at the very least, a name, representation, and links to objects are both, below, and parallel to it. Representation could be text or pictures or movies or audio or any other media representation. Of course multiple representations are possible. If the object is a concept, it would of course need to be defined by its features. Also there would be examples and non-examples. These would be represented by links to other objects. For example, an example a mammal is a dog, which itself is a concept. In fact, a dog is a kind of mammal and therefore kinds of mammals would also have to the represented. If the object is a procedure we might need to represent an actor, the actor's purposes, the steps in the procedure, the order of the steps, the actions needed to perform a step, and results of each step, and the main result of the procedure itself.

Naturally, for processes we would need to represent the phases in the process, the order of the phases, the actions that take place in each phase, the results of each action, and the initial state and the final state of the process. If the object is an entity we would need to represent its parts. Each part would have and name and a representation. Entities might also have structures, quantities, and magnitudes or sizes.

If we're going to represent relationships we might distinguish between unary or binary relationships or symmetrical and asymmetrical relationships or many others. In fact, one problem with relationships is that there doesn't seem to be any small finite set which can be conveniently listed. It may be that this defining of relationships will have to be left to the author.

Another possible attribute of an object is its history. An object may belong to a particular historical period, or be the result of a historical process, or have ancestors or descendants. Naturally, an object will have its own history of when it was created and by whom and where.

This list of objects and attributes is not intended to be complete but is offered as a suggestion of the kinds of objects and attributes it would need to be represented in order to be processed by an instructional agent.

5. Representing Knowledge Objects for Instructional Purposes

Following Merrill, in instructional design it is usual to speak of entities, concepts, processes, and procedures. I have followed this pattern in the design of might knowledge objects, while adding a fifth object, relationships.

5.1 An Ontological Grammar

My ontology is represented as a phrase structure grammar which allows recursive embedding of knowledge objects.

The basic rules of the grammar are as follows. First it consists of the fundamental "parts of speech" of the grammar, i.e., the knowledge objects:

O = Object
R = Relationship Object
C = Concept Object
E = Entity Object
Ps = Process Object
Pd = Procedure Object

Then the grammar defines a combinatorial algebra for the objects:

$O \Rightarrow O\ R\ O$

In a grammar such as this, the arrow (⇒) may be read as "may be rewritten as."

$$O \Rightarrow \begin{Bmatrix} C \\ E \\ Ps \\ Pd \end{Bmatrix} \text{ -- Curly brackets are used to indicate a choice.}$$

$C \Rightarrow N + Rep + K + F + D + Sub\text{-}B + Ex + Non\text{-}Ex$
$E \Rightarrow N + Rep + P + Q + U + Mq + Mu + Syn + Part\text{-}Sub$
$Ps \Rightarrow N + Rep + Ph + Sub\text{-}El + Purp$
$Pd \Rightarrow N + Rep + Steps + Sub\text{-}El + Goal$
$R \Rightarrow N + One2One? + Concept$

Each object represented in the grammar is a complex combination of variables and behaviors (executables).

N ⇒ (Name (text variable)
Rep ⇒ (Representation: text, picture, movie, audio, or scene(s))
K ⇒ (Kinds: list variable)
F ⇒ (Features: list variable)
D ⇒ (Definition: text variable)
Sub-B ⇒ (Sub-behaviors. Concept behaviors related to the kinds)
Ex ⇒ (Examples: Entity behaviors)
Non-Ex ⇒ (Non-examples: Entity Behaviors)
P ⇒ (Parts: A list variable)
Q ⇒ (Quantity: A floating point variable)
U ⇒ (Units: A text variable)
Mq ⇒ (Magnitude-quantity: quantity in standard measure)
Mu ⇒ (Magnitude units: standard units)
Syn ⇒ (Synonyms: A text list)
Part-sub ⇒ (Parts of the Entity: behaviors corresponding to the parts list)
Ph ⇒ (Phases: A text list)
Sub-El ⇒ (Sub elements of the Process. Each is a concept)
Purp ⇒ (Purpose of the process: A Concept behavior)
Steps ⇒ (Steps of the procedure: A text list.)
Sub-El ⇒ (Sub-elements corresponding to the Steps list: Each is a concept)
Goal ⇒ (Goal of the procedure: A concept behavior)
One2One ⇒ (One to one: An integer range variable which defines whether the relation is one to one or one to many)

6. Combining Objects into Logical Structures

As defined by the above grammar, any object can be transformed into an object-relation-object structure. Needless to say, relations are also objects but they are defined in a special way in this grammar. A relationship can only be the child of another object in cannot stand alone.

As this relationship object illustrates any object can be the child of any other object. In other words a process can be the child of a concept or an entity can be the child of a procedure. In this way an infinite set of knowledge object trees can be structured from a finite set of objects and relations, so a large body of knowledge can be constructed from a set of relatively small objects. Given such a description, it can be seen that several tools will be necessary both on the authoring side an on the client side. On the authoring side we would program which allows us to create knowledge objects without worrying too much about syntax. Once the objects are created they can be made available by a normal Web server. This side of the equation seems readily doable.

However, on student or client side is not clear that any current or foreseeable browser would be sufficient. Although typical browsers could navigate the links in the knowledge objects they would not incorporate instructional strategies and thus would not constitute an instructional engine. Also, it seems that simple instructional strategies are not sufficient in an instructional situation. A human tutor does not simply present information questions to a student and react blindly to the students responses. It is here that some kind of instructional discourse engine would be necessary.

In this context, Grice's conversational maxims may be helpful. According to [Grice, 1974], cooperative behavior in conversation can be described in terms of four conversational maxims:

1. The maxim of quantity: where one tries to be as informative as one possibly can, and gives as much information as is needed and no more

2. The maxim of quality: where one tries to be truthful, and does not give information that is false or that is not supported by evidence

3. The maxim of relation: where one tries to be relevant, and says things that are pertinent to the discussion

4. The maxim of manner: where one tries to be as clear, as brief, and is orderly as one can in what one says, and where one avoids obscurity and ambiguity.

While there is some controversy about the appropriateness of using these maxims to describe all conversations that need not bother us here. Grice's maxims offer us a good guideline as to the types of operations which instructional discourse engine should be able to perform. For example, the student should be able to ask for more or less information in accordance with the maxim of quantity. In this way the student should be able to control the number of examples and the degree of detail provided for a particular knowledge object. In addition, this control should make predictions about the amount of information needed by the student in order to understand related ideas.

Secondly, the maxim of quality can be invoked, not when the student doubts the truth of a particular proposition, but when a student cannot see the reason why a particular proposition may be true. Thus, the instructional discourse engine should be able to supply additional evidence in support of a particular proposition. It can do that by navigating the knowledge tree either by going lower and gathering more details or by going higher and presenting an overriding principle which the student may have missed or forgotten for some reason.

When a student cannot see why something is relevant, he should be able to invoke the maxim of relation and ask the instructional discourse engine to show why the current knowledge object is relevant to the educational purpose at hand. Since the engine can extract the relationship between the current object and its parent object or sibling objects it should be able to construct an argument based upon that relationship.

Finally, since the instructional discourse engine can see the knowledge tree it should be able to construct an instructional trajectory which is as brief is possible, in accordance with the maxim of manner. Again, if the student feels that the engine is being ambiguous or obscure, he should be able to request that the engine justify its path.

Although this is purely personal and anecdotal, it seems to me that whenever I am frustrated with computer-based instruction, the source of the frustration can be traced to a violation of one of Grice's four maxims. Building such an instructional discourse engine may not be easy but at the very least it requires networks of knowledge objects which are linked into trees which can be logically navigated. Thus, the first step in this project is to work towards an acceptable description language for instructional knowledge objects.

7. Summary

These suggestions only sketch an early stage in the design of an instructional ontology. The actual structure of the description language will need to conform to the results of empirical experience. However, it is plain that some sort of progress along this path will be necessary for the development of efficient and effective instructional design.

8. References

Grice, H.P. (1974). Logic and Conversation. In P. Cole and J.L. Morgan (eds.): *Syntax and Semantics*, Vol. 3, 41-58. NY: Academic Press.

Gruber, T. R. (1993). Towards principles for the design of ontologies used for knowledge sharing. Technical Report KS L 93-04. Knowledge Systems Laboratory, Stanford University.

Gruber, T.R. (n.d.). What is an ontology? [WWW document] URL http://www-ksl.stanford.edu/kst/what-is-an-ontology.html.

Merrill, M.D. (n.d.). Instructional transaction theory (ITT): Instructional design based on knowledge objects. [WWW document] URL http://www.coe.usu.edu/coe/id2/ddc0997.html)

Student Modelling Review-What can be learned for Distance Education?

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Abstract: Our research concerns the applicability of the existent Student Models in the area of distance education. In the current study a number of Student Models are reviewed. A short description of the models, their bibliographic reference in addition with a short discussion on their applicability in the area of distance education is going to follow.

Student Model a short definition

In general terms, student modelling involves the construction of a qualitative representation that accounts for student behavior in terms of existing background knowledge about a domain and about students learning the domain. Such a representation, called a student model, can assist an intelligent tutoring system, an intelligent learning environment, or an intelligent collaborative learner in adapting to specific aspects of student behavior [McCalla, 1992 a].

Types of Student Models.

According Anderson, Corbett and Koedinger there are actually two types of Student modelling, which called knowledge tracing and model tracing [Anderson et al., 1995, p. 167-207]. These are their names for the particular techniques they use, but the distinction is perfectly general. Knowledge tracing refers to the problem of determining what students know, including both correct domain knowledge and robust misconceptions.

Model tracing refers to tracking a student's problem solving as s/he works on a problem. Model tracing is useful for systems that attempt to answer requests for help or to give unsolicited hints and feedback in the middle of problem solving. In fact, to do an adequate job of helping, hinting and critiquing an on-going solution attempt a system must at minimum understand what line of reasoning the student is attempting to pursue. On the other hand, knowledge tracing is useful for making longer range pedagogical decisions, such as what problem to assign next or what evaluation grade to assign to the student. All the existing attempts to apply probabilistic reasoning to student modelling have been directed toward performing knowledge tracing only. [Conati and VanLehn, 1996]

Giangrandi Paolo and Carlo Tasso who have criticized the concept of a static and of a temporal student model have provided an additional differentiation on the concept of student modelling. According to their definition a model which describes the student's knowledge without considering the possible evolution in time is called static while a description of the temporal history of the student's knowledge that includes all the information about the student and makes it possible to explain the student's behaviour for both the past and the current interaction is called temporal.[Giangrandi & Tasso, 1996, p. 184-190; Giangrandi & Tasso, 1997, p. 415-426].

MaCalla introduces two other types of student model the explicit and the implicit student model and makes a useful distinction between them [McCalla, 1992 b, p. 107-131]. An explicit student model is a representation of the learner in the learning system that is used to derive instructional decisions. An implicit student model is reflected in design decisions that have been derived from the system designer's view of the learner.

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Examples of Student Models.

In the first part of this section a number of domain independent Student Models are going to be illustrated while in the second part a short description of domain dependent Student Models is going to be provided.

Section 1: Domain independent Student Models

Jim Greer and Gordon McCalla, in their book "Student Modelling: The Key to Individualized Knowledge-Based Instruction" [Greer & McCalla, 1994] make a reference to a number of domain independent Student Models introduced by Kass [Kass, 1989, p. 386-410].

Overlay Student Model

According to this model the learner's knowledge at any point is considered as a subset of an expert's knowledge. The objective of instruction is to establish the closest possible correspondence between the two sets. In such approach it is assumed that all differences between the learner's behavior and that of the expert model can be explained as the learner's lack of skill [Fig. 1]

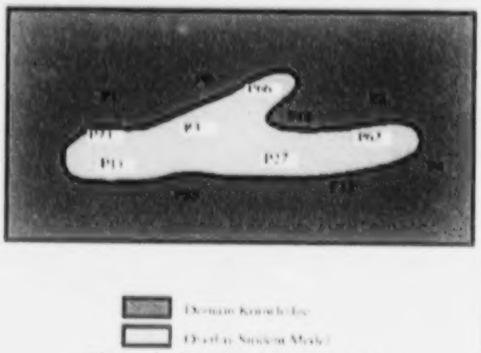

Figure 1: Overlay Student Model

The Overlay Student Model works well for systems where the goal is to strictly impart the knowledge of the expert to the learner. On the other hand the main problem with this model is that the model assumes that a learner's knowledge can be merely a subset of an expert which may not be the case [Greer and McCalla, 1994,p. 7]

Differential Student Model

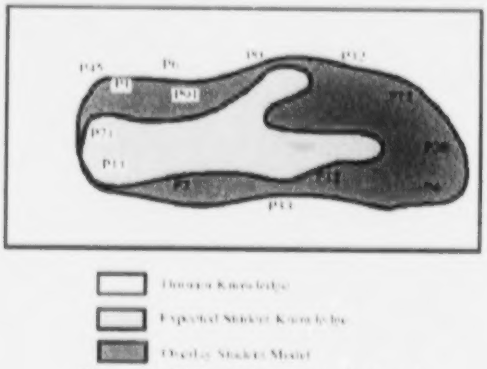

Figure 2: Differential Student Model

According the Differential student model-which is a modification of the overlay student model - learner's knowledge is divided in two categories: knowledge that the learner should know and knowledge that the learner could not be expected to know [Fig. 2].

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So in contrast with the overlay student model this model does not assume that all gaps in the student model are equally undesirable. Furthermore the differential student model acknowledges and tries to explicitly represent both learner knowledge and learner-expert differences.

Perturbation Model and Bug Models

While the overlay model represents the learner only in terms of "correct" knowledge, a perturbation model normally combines the standard overlay model with a representation of faulty knowledge [Greer & McCalla, 1994, p. 8]. Furthermore in the perturbation model the learner is not considered as a mere subset of the expert but the learner will possess knowledge potentially different in quantity and in quality from the expert knowledge.

The perturbation model maintains a close link between the learner and the expert models but can also represent the learner's knowledge and beliefs beyond the range of the expert knowledge [Fig 3]

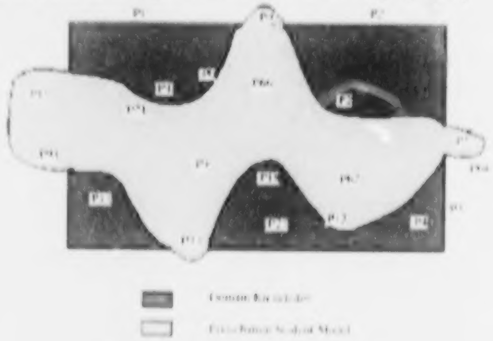

Figure 3: Perturbation model

This model utilizes a bug library which is a fixed collection of bugs and of student's misconceptions. As bug is defined a structural flaw in the procedure that manifests itself in faulty behavior. The inclusion of the bugs in the perturbation model allows more sophisticated understanding of the learner than can be accomplished with a simple overlay on the expert model.

Constrained based Student Model

A constraint based student model represents the learner as the constrains upon the correct knowledge representation. This extends the standard overlay model approach by permitting much more sophisticated reasoning about domain concepts beyond whether they are known or not. A violation of those constraints by the learner indicates that the model needs to be updated. This model is computationally simple and does not prescribe a particular tutorial strategy and it is further unclear how this approach will generalize across domains and tutorial strategies.

Fuzzy Student Model

The fuzzy student model was initially introduced by Hawkes and Derry [Derry & Hawkes,1992] and was further developed by Katz and Lesgold in the SHERLOCK system [Katz & Lesgold, 1992, p. 205-230]. In such model statistical procedures are used to propagate changes from observable actions to local variables to more global variables. The presence or absence of the knowledge variables are represented by a probability distribution on five levels of the knowledge variable ranging from no knowledge to fully developed knowledge.

PairSM Student Model

PairSM is a domain-independent system introduced by Susan Bull and Smith Matt aimed at helping pairs of students to organize their revision for an approaching test [Bull & Matt, 1997, p. 339-341]. PairSM contains two individual student models which are compared by the system to enable it to suggest ways in which two students may work together effectively. It can recommend collaborative learning, peer tutoring or individual learning, depending on the comparative contents of the models. The aim is to encourage students to experience the benefits of peer interaction.

The two student models of PairSM are initially based on the results of a multiple choice pre-test entered by the tutor. The models are updated by subsequent tests. PairSM contains heuristics for recommending the kind of preparation which may be useful for the learners, by comparing the contents of the two student models, and the manner in which the learners have acquired further knowledge. An overview of the student models is given in Figure 4.

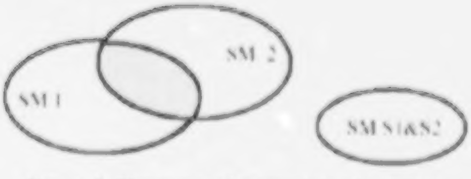

Figure 4: The two student models of pairSM.

SM 1 represents the concepts known by Student 1, and SM 2, those known by Student 2. The intersection of SM 1 and SM 2 represents shared knowledge. SM S1&S2 represents knowledge that the two students can display when working together, but that they cannot produce individually. SM-S1S2 represents knowledge that the pair can display when working together, resulting from one or both knowing the concepts individually, or from interaction between the two learners. SM-S1S2 is the union of SM 1, SM 2 and SM S1&S2 [Bull and Smith 1997, p. 339-341].Simplified descriptions of the possible situations for each of the individual students are:

no intervention
suggest S1 learn individually
suggest S2 learn individually
suggest collaboration
suggest peer tutoring S1 -> S2
suggest peer tutoring S2 -> S1

For a given topic PairSM may recommend one or more of the above.

See Yourself Write Student Model

The See Yourself Write - introduced by Susan Bull -is a system comprising two parts: a template through which the teacher gives students feedback on each writing assignment they complete, and an individual student model which is automatically created from the feedback provided by the teacher, and which is built up over time[Bull, 1997, p. 315-326]. The student model of See Yourself Write is inspectable, to promote learner reflection and to encourage learners to use the feedback received from their tutors in their future assignments. The domain is writing in a foreign language. See Yourself Write differs from other computational writing environments containing a learner model because the aims differ.

The aim of the See Yourself Write student model differs from that of more conventional learner models in that it is not intended as a source of information for a computational educational system, but rather as a source of information for the student. It reflects to students feedback on their own work, and information about how they are progressing and about their overall performance. Information in the student model is both qualitative and quantitative. Its main purpose is to promote learner reflection on completed assignments in such a way as to lead students to use this feedback to improve subsequent work.

The student model includes both quantitave and qualitative information on student's progress information which can be viewed easily by the student. In addition, the quantitative information (teacher's feedback) is evaluated by the system to provide a more general overview student model to be used by the student in conjunction with feedback on individual assignments.

Section 2: Student Models with domain dependency.

OLAE and POLA Student Model.

OLAE is an off-line probabilistic assessment tool that collects data from students solving problems in introductory college physics. It provides an interface that presents problems and allows the student to solve them by entering algebraic equations. OLAE uses the student's actions to assess the probability that the student knows the physics rules encoded in its model of physics knowledge. The assessment is performed off-line by propagating the evidence provided by the student's actions into a Bayesian network built upon an AND/OR graph representation of the problem solution. The problem solutions are generated forward chaining by the problem solver starting from the problem givens and firing rules as soon as they become applicable. Three kinds of nodes are present in the AND/OR graph. 1) Rule nodes (rectangles in Fig. 5) that represent rules and problem givens. 2) Application nodes (ellipses in Figure 6) that explicitly represent rules firing. 3) Fact nodes (diamonds in Fig 5), that represent conclusions derived during problem solving.

Application nodes are the AND nodes in the graph, while fact nodes are OR nodes modelling the fact that some conclusions can be derived in multiple ways. Each application node is connected to the fact node representing the derived conclusion. OLAE assesses the student knowledge of physics rules from the student's solution of a problem using a Bayesian net-work consisting of the AND/OR graph for that problem integrated with nodes that represent the equations entered by the student, called action nodes. Each node in the Bayesian network has values TRUE/FALSE, which represent [a] for a rule node, whether the student knows the corresponding rule. [b] For an application node, whether the student actually used a rule during the problem solution. [c] For a fact node, whether the student knows the associated fact about the given problem. [d] For an action node, whether the student has performed the action.

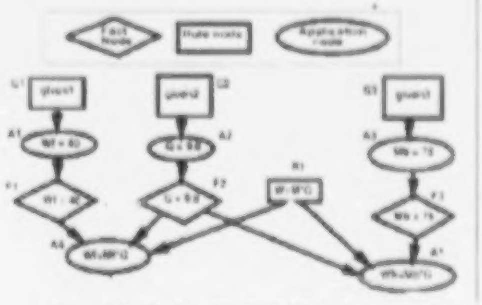

Figure 5: OLAE Student Model

As it is referred by Conati and VanLehn propagation through this network caused incorrect assignment of probabilities [Conati and VanLehn, 1996]. For that reason the further enhance OLAE student model by developing POLA. POLA is a student modelling framework that performs probabilistic assessment of students' performance while they solve problems in introductory Physics. POLA turn OLAE- system that performs probabilistic knowledge tracing-into a system that applies probabilistic reasoning to perform both knowledge and model tracing. POLA generates probabilistic predictions about the student's line of reasoning without using heuristics, even when the problem's solution space is large. Similarly to OLAE a Bayesian network is constructed incrementally from the AND/OR graph and from the student's actions generates predictions about the solution that the student is following. At the end of the problem solving session the network provides an assessment of student's level of mastery of the physics knowledge involved in the problem's solution. POLA builds the Bayesian network incrementally from the AND/OR graph as the student enters actions, but keeps the two structures separately. For each new action that the student types, POLA determines which rules and which givens have been used to derive it. If there is more than one way to derive the student's action the analysis returns the set of possible derivations, each of which is a distinct but possibly overlapping set of rule applications and givens. Derivations are represented explicitly in the Bayesian network by what we call derivation nodes. After each new equation entered by the student the Bayesian network is extended with an action node that represents the equation and with a derivation node for each derivation producing the equation. The derivation nodes are linked to the action node through a leaky-XOR link matrix. Additionally in case where a certain problem has different solution sets a new type of nodes are inserted in the network called solution nodes. Once a solution sets have been identified, POLA starts creating the Bayesian network adding a solution node for each solution set.
POLA represents a new approach to applying Bayesian networks to student
modelling, since the other existing efforts to use probabilistic reasoning in student modelling have been focused on knowledge tracing only [Conati & VanLehn, 1996].

Discussion

The development of new technologies has promoted an astounding growth in distance education, both in the number of students enrolling and in the number of universities adding education at a distance to their curriculum. A great number of students of different ages participate in courses available via distance.
Teaching and learning at a distance requires special attention to the possibilities and limitations of the technologies involved. Even many simple activities, which we take for, granted as part of the instructional process must be reconsidered and adapted to new circumstances. Pedagogy of distance education can be broken in issues which concern the instructor, and issues which concern student. We believe that the study of student models can

positively affect the area of distance education assisting towards better teaching and learning activities to be achieved.

Our research interest focuses on the utilization of domain independent student models in the area of distance education according to the age of the potential student. Having in mind that the human knowledge space increases according to human's age, the Overlay Student Model can be applied with accuracy in cases where of the potential student is not an adult. It is considered that the knowledge space of such student -due to the age factor- is in most of the times a subset of tutor's knowledge space. On the other hand the Differential and the Perturbation Student Model can be applied in cases where the potential student is an adult as these models assumes that all gaps in the student model are equally undesirable, nor the learner knowledge is considered as a mere subset of the expert (tutor). On the contrary the learner is assumed that possess knowledge potentially different in quantity and in quality from the expert knowledge. It is worth to noticed that the utilization of bug library in order students faulty behavior to be highlighted is applicable to potential students regardless of their age. Applicability of a student model regardless of the age of the potential student is also valid for the Fuzzy Student Model, while the Constrained based Student Model can be applied in cases where the taught domain is deterministic.

Pair SM Student Model is of exceptional interest as it s not only applicable regardless of the age of the potential student but it can also be used to monitor collaborative learning, which is a critical issue in the area of distance education. Furthermore the See Yourself Write Student Model although it is implemented to improve writing skills in a foreign language can be used as a domain independent student model which aiming to improve student's performance by utilizing the tutor's feedback.

References.

1. Anderson, J.; Corbett, A.; Koedinger, K., and Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences* 4[2]:167-207 NJ: LEA.
2. Bull Susan (1997) See Yourself Write: A Simple Student Model to Make Students Think, User Modeling: *Proceedings of the Sixth International Conference*, UM97 Vienna, New York: Springer Wien New York: 315-326.
3. Bull Susan and Matt Smith (1997). A Pair of Student Models to Encourage Collaboration, User Modeling: *Proceedings of the Sixth International Conference*, UM97 Vienna, New York: Springer Wien New York,.
4. Conati, C. and VanLehn, K. (1996). POLA: A student modelling framework for probabilistic on-line assessment of problem solving performance, *Fifth International Conference on User Modelling* UM-96, Kailua-Kona, HI: User Modeling Inc.
5. Derry, S. J. and Hawkes, L. W. (1992). Toward fuzzy diagnostic assesment of metacognitive knowledge and growth, *American Educational Research Association*, San Fransisco, CA.
6. Giangrandi Paolo and Carlo Tasso (1997). Managing Temporal Knowledge in Student Modeling, User Modeling: *Proceedings of the Sixth International Conference*, UM97 Vienna, New York: Springer Wien New York: 415-426.
7. Giangrandi, P., and Tasso, C. (1996). Modeling the temporal evolution of student's knowledge. In Brna, P., Paiva, A., and Self, J., eds., *Proceedings of the European Conference on Artificial Intelligence in Education*. 184-190.
8. Greer, J. E. and McCalla, G. I., (1994). Student Modelling: *The Key to Individualized Knowledge-Based Instruction*, NATO ASI, Series F. Springer-Verlag.
9. Henrion, M. (1989). Some practical issues in constructing belief networks. In Kanal, L. N., Levitt, T. S., and Lemmer, J. F., eds., *Proceedings of the 3rd Conference on Uncertainty in Artificial Intelligence*, Elsevier Science Publishers : 161-173.
10. Kass, R. (1989). Student Modelling in intelligent tutoring systems-implications for user modelling. *User Models in Dialog Systems* [A. Kosba & W. Wahlster, eds], Berlin, Springer-Verlag: 386-410.
11. Katz, S and Lesgold, A (1992): Approaches to student modelling in SHERLOCK tutors. *3rd International Workshops on User Modelling*, Wadern , Germany , Kaiserslautern:DFKI, 205-230
12. McCalla, G. (1992 a). The central importance of student modelling to intelligent tutoring. In E. Costa [Ed.], *New Directions for Intelligent Tutoring Systems*. Berlin: Springer Verlag.
13. McCalla, G. (1992 b). The centrality of student modelling to intelligent tutoring. In E. Costa [Ed.] NATO ASI, Series F., Vol 91, Berlin Springer-Verlag, 107-131.
14. Pearl, J. (1988). Probabilistic Reasoning in Intelligent Systems: *Networks of Plausible Inference*. San Mateo, CA: Morgan-Kaufmann
15. Russell, S., & Norvig, P. (1995). *Artificial Intelligence: A Modern Approach*. Los Altos, CA: Morgan-Kaufmann.
16. VanLehn, K. and Martin, J. (1997). Evaluation of an assessment system based on Bayesian student modeling, 8, 179-221.
17. Ulrich Hoppe (1995): The Use of Multiple Student Modeling to Parameterize Group Learning, ***Workshop in Artificial** Intelligence in Education 95*. Electronic version at http://collide.informatik.uni-duisburg.de/Publications/Html/ aied.95.html, downloaded at 20/2/99.

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The Multi-Site Course: Using Technology to Enable Global Course Offerings

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Abstract: The Stanford Overseas Studies Program has offered students at Stanford University the opportunity to study abroad for the past forty years. In the 1998-1999 academic year, the program took its first step towards utilizing technology to offer its students multi-site courses -- courses taught by a single faculty member with students participating from several overseas centers. This paper presents the issues encountered in offering globally distributed courses and makes recommendations for others interested in offering similar courses.

Introduction

Many universities are involved with expanding the scope of their course offerings via distance education. Last year, for example, the School of Engineering at Stanford University began to offer a Master's degree which could be earned solely via distance education. The Stanford Overseas Studies Program has also been interested in exploring ways to utilize technology to benefit its students. The development of the multi-site course format is a result of recent explorations.

The Stanford Overseas Studies Program is one of the first overseas studies programs at a major university to offer courses where students in a particular course are distributed in centers throughout the world. One of the primary reasons for exploring this multi-site course format was to enrich students' experience in the course through interactions, discussions, and collaborations with others studying and living in different cultures. Every effort was given to guarantee that these courses equaled, if not surpassed, other course offerings in meeting students needs.

This paper will focus on case studies presenting an analysis of the implementation of the multi-site courses during the 1998-1999 academic year. Included in the case studies will be background information on the Stanford Overseas Studies Program and its use of technology; a description of the courses; an analysis of the courses, including a description of the course structure and technology. This paper shall conclude with recommendations for those interested in conducting a multi-site course of their own.

Background

The Stanford University Overseas Studies Program has offered students at the university the opportunity to study abroad for the past forty years. Stanford has overseas centers located in Oxford, England; Paris, France; Florence, Italy; Berlin, Germany; Kyoto, Japan; Moscow, Russia; Santiago, Chile; and Puebla, Mexico. Courses offered at the centers are taught by local instructors as well as visiting Stanford faculty.

While administrators of some overseas studies programs have been fearful of the use of technology in their programs, Stanford Overseas Studies has been supportive of the use of technology in its overseas centers for the past ten years. Those who oppose the use of technology in overseas programs believe it encourages students to stay too connected with their home campus and country, thus interfering with their overseas experience. Although the use of technology at Stanford's overseas centers has generally been limited to students using the computers for word processing, accessing email, and "surfing" the web, Stanford Overseas Studies has been very interested in expanding the use of technology to enrich its overseas course offerings. The use of technology offers the means to expand course offerings by making courses available at multiple sites, as well as making better use of local overseas experts, having them appear as guest lecturers in courses at the Stanford home campus.

Stanford Overseas Studies' first step towards greater use of technology has been the collaboration on various technology based projects with different groups on the Stanford campus. Last spring quarter, together with Stanford Online, for example, engineering students in the Berlin and Kyoto centers were offered the opportunity to take courses via Stanford Online's web based format which utilized a streaming video technology, vXtreme, to present lecture material.

It was not until this past year, however, that Stanford Overseas Studies was able to hire an additional staff member, the Academic Technology Manager, who enabled them to move forward with their agenda to more fully utilize technology in their courses. Stanford Overseas Studies submitted a proposal and was selected to participate in the Academic Technology Specialist Program which is managed by Research and Instructional Technologies Support of the Stanford University Library/Academic Information Services. Academic Technology Specialists provide to faculty on-site, intradepartmental consulting and support in information and instructional technology for academic purposes to foster their awareness and use of technological resources, both within and outside of the university. In the case of Stanford Overseas Studies, their Academic Technology Manager would play a vital role in overseeing the management of the multi-site courses.

Course Descriptions

Stanford Overseas Studies' first multi-site course was a Religious Studies course, "Religion in Culture," which was offered in the fall quarter of 1998. Students in this course studied the different ways in which religion forms and is formed by culture. After an examination of different theoretical approaches to that subject, students worked on projects that drew on the resources of their local sites. Examples of such projects included understandings of the relation of religion (e.g., the church) to the state, depictions of specific sacred themes in art and architecture, the character of distinctive religious activities such as pilgrimage, and the significance of holy people, living and dead, for some believers.

This Religious Studies course involved participants from five different locations. It was taught by a Stanford faculty member who was based at the Florence center. The teaching assistants for the course were located at the Stanford campus in Palo Alto, CA. While the course was open to students at any of the overseas centers, a total of nineteen students from the Florence, Paris, Berlin, and Oxford centers enrolled.

The second multi-site course was a Comparative Literature course, "Literary Institutions," which was offered in the winter quarter of 1999. In this course students examined institutional structures and contexts for literature in different studies. However, rather than focusing on the close readings and interpretation of particular works, students explored how literature is presented to its public at various levels. Some of the questions raised in the course included: What sorts of literature are discussed in the press, and what are the issues raised by such literary criticism? How is literature presented in schools? Is it primarily the "local" national literature or is "world literature" read? Do students read "minority authors"? What texts are taught at universities, and what plays performed in theaters?

The Comparative Literature course involved participants from six different sites. While the faculty member and teaching assistant were located at the Stanford campus in CA, the twenty-four students in the course participated from overseas centers in Oxford, Paris, Berlin, Florence, and Santiago.

Course Structure

Traditional modes for delivering distance education courses have been correspondence courses, courses on audio and video tapes, and satellite/cable broadcast courses. These formats have been most successful at delivering educational programs based on the "traditional" delivery of knowledge model of learning, which treats learners as passive recipients of information. The active learning model, however is based on the notion that more effective learning is achieved when the learner is actively engaged in the creation of knowledge rather than the passive recipient of information. More specifically, learning is achieved within an environment that fosters interactions between learners and instructors, between learners and content experts, and amongst learners themselves.

In order to ensure that the multi-site courses were not just email or web based correspondence courses, an active learning, or learner centered, model was adopted for the multi-site course format. The faculty structured the courses to be project based and emphasized collaborative work amongst students, encouraging students from different centers to work together. This structure required students to complete a significant amount of field research in their local environment. The technology used in the course not only allowed students to communicate with the faculty member, but also enabled them to share their research and experiences from their host countries with one and other. The multi-site courses also employed the use of local mentors at each of the overseas centers. The local mentors were content and/or language experts of the native country. Their primary role was to assist students in accessing local resources when conducting their research. Since students did not have face to face contact with the faculty member teaching the course, it was important that the local mentors were not perceived as "local" instructors for the course. Otherwise, if the students perceived the local mentors as local, or "surrogate," instructors, they could have begun to rely on the local mentors as "the instructor" and their online participation would have suffered. The course could have become fragmented and "mini courses" might have developed at each center.

Technology

A course web site was constructed for each of the multi-site courses. These web sites included course related information such as the syllabus, assignments, a calendar, and a web based discussion software. The discussion software was utilized as the primary means for interaction between the faculty member, teaching assistants and the students.

Students utilized the computer clusters, available at each of the overseas centers, to access the course web sites. The clusters consisted of Macintosh computers and a laser printer. A flat bed scanner and Sony Mavica digital camera were also available to allow students to capture images and upload them along with their postings. Sony digital cameras were selected because the use of regular floppy disks as the recording media, a familiar technology, made it easier for students to transfer their images and upload them with their postings. Students utilized the cameras to include photographs of literary institutions they visited in their local communities.

The Academic Technology Manager acted as the technical liaison coordinating the campus computing resources for the faculty member, teaching assistants, students, and overseas center staff. Because these courses were somewhat experimental in nature, the Manager's role was crucial in ensuring that the proper technologies were in place in order for the courses to be conducted. In addition, the Manager acted as the system administrator for both courses.

Web Crossing, by Lundeen Associates, was the threaded discussion software utilized to support the Religious Studies course. Web Crossing provided the capability to setup folders to organize course discussion according to topic, assignments, or group project. The faculty member and teaching assistants determined the structure of the folders for the course discussions prior to the beginning of the course.

The Comparative Literature course utilized the Forum, a web based discussion software developed by the Stanford Learning Lab, to support course discussions. The Forum was selected because it provided additional functionality over Web Crossing, and its interface provided a more efficient method for navigating discussion threads. In order to combat the connectivity problems that were experienced in the previous multi-site course, the Stanford Learning Lab was able to provide use of a dedicated line to Sweden that one of its other project partners was utilizing. Use of this line meant that the course web server could reside on the Stanford campus, but appear to be located in Sweden since it was assigned a Swedish IP address. Students at the European centers utilized the Swedish server address in order to route their traffic to Stanford via the Swedish dedicated connection, thus bypassing any bottlenecks on the east coast of the United States. Students from the Santiago Center successfully accessed the course server utilizing the Stanford server address.

A Comparative Analysis

Since course participants in the Religious Studies course were distributed in five different countries it was decided that Web Crossing, a web based discussion application, would be an appropriate technology for providing a rich "classroom environment."

While Web Crossing has the capability to include images along with postings, as well as a chat component, neither of these functions were used, however, in the Religious Studies course because of connectivity problems. Both the Web Crossing server, as well as the web server for the course web site, were located on the Stanford University campus. Access to these servers from the European centers was very slow and unreliable during most of the day (8 am - 11 pm). Connection speeds were so poor that students generally surfed the web with images turned off. Given that conducting telnet sessions was difficult at best, it was decided that synchronous communication was not feasible given the current connectivity between the centers and Stanford campus.

While the course was ultimately successful, a number of other difficulties were encountered. The overseas centers lacked the on-site support staff necessary to adequately support students who had difficulty using the technology. In addition, the faculty member and teaching assistants had limited experience using "advanced" technology prior to teaching this course. They were previously primarily familiar with word processing and email.

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While they were ultimately able to learn and effectively utilize the discussion software, it was at times a struggle and a stressful process. Lastly the normal course "house keeping" issues became much more difficult and time consuming to manage with the course being distributed amongst several locations. Registering a distributed group of students into the system and issuing logins and passwords took a significant amount of time and effort.

The faculty member and teaching assistants felt that the course succeeded on many different levels. While it took some time for the students to adapt to the different learning environment, once they felt more comfortable and adjusted to the connectivity problems, they were motivated to participate in the online discussions. In fact the volume of the number of postings surprised the faculty member and teaching assistants. They were especially surprised by the frankness in which the students shared personal information, such as their religious background, which would never had occurred in a "conventional" classroom.

A course web site which incorporated the use of the Forum, a web based threaded discussion software developed by the Stanford Learning Lab, was utilized as the primary vehicle for (asynchronous) communication in the Comparative Literature course. The Forum provided the faculty member the capability of creating folders to organize the course discussions and assignments.

Because the Comparative Literature course had the benefit of utilizing the direct line to Sweden, it was determined that there was sufficient connectivity to support a synchronous communication component in the course. A simple chat client was integrated into the course web site. Weekly chat sessions were conducted as a follow up to weekly assignments, to discuss and share research findings, as well as build a sense of community for the students in the course.

Weekly assignments were posted on the course web site. Students would then post completed assignments into the appropriate folder within the Forum. In order to ensure that students participated in online discussions, students were required to post a minimum of five initial responses to a topic question and respond to at least one topic thread each week. There was less instructor participation in discussions as the quarter progressed in order to allow students to take full ownership of the discussions. In addition, students easily incorporated digital images or other documents (e.g., Microsoft Word, etc.) as attachments to their postings.

In addition to posting assignments to the Forum, the students were involved in a real time chat session (synchronous communication) with the faculty member once a week. The chat sessions were conducted after the weekly assignments had been posted to the Forum. These sessions gave the faculty member and students an opportunity to further discuss assignments in real-time. These sessions also served as a vehicle for building a sense a community for the students in the course.

While Web Crossing displayed the contents of a single discussion folder per screen, the Forum software utilized a three paned window to display a listing of folders, a listing of messages in a folder, and the contents of a specific message. In general its interface was more flexible and took less time to load in a browser. In addition the Forum provided a means for the faculty member to make general course announcements and easily include attachments (i.e. images, Word documents, etc.) with their postings. Another very beneficial feature was the email copy feature available when posting messages. The Forum provided users with the ability to send, via email, a copy of any posting to a specified group of users (i.e., the faculty member, faculty member and teaching assistants, all students in the course, students from a specific center, etc.).

The faculty member played a key role in the success of the Comparative Literature course. His use of a learner centered approach in structuring the course was a major factor in its ultimate success. Because he was a more experienced user of technology, he had an easier time learning to effectively use the technology to manage his course. At the beginning of the course, he spent a significant amount of time and effort online in creating the feel of a community for the course, responding to every student posting in the Forum. In these postings, he would repeatedly emphasize to students that they should look to one and other as resources, encouraging them to seek out other students, especially those at other centers, to collaborate with on their projects.

Conclusion

Stanford Overseas Studies found that the development of the multi-site course format gave us the opportunity to create exciting globally distributed learning communities in which students became active learners, local researchers, and collaborators engaged in real and personal learning activities. The inclusion of students from centers in different countries added an additional dimension of incorporating multiple perspectives on important topics, issues, events.

This shift from the passive to active model of learning required a shift in the roles of both faculty member and students. The cooperation of the faculty member in modifying their teaching style was very important to the success of the multi-site courses. The faculty member no longer played the familiar role of "disseminator of the knowledge." His/her role became one of facilitator instead. Rather than requiring a major term paper, students were encouraged to work collaboratively in completing a group project. The formation of groups was facilitated by the faculty member. S/he encouraged students with like interests to work together; especially students from different centers.

In developing the multi-site course format, every effort was given to guarantee that these courses equaled, if not surpassed, other course offerings in meeting students needs. That is, the multi-site course was not the repackaging of a course delivered via distance technologies. Special care was given to ensure that the technology used in the course did not become the focus, or interfere with the content, of the course. A major restructuring of the course, including a shift to a learner centered methodology, was thus necessary to utilize the technology in a way to maximally benefit the students in the course. In other words, having the faculty, students, and technology staff embrace a learner centered methodology was a key to the success of the multi-site course format.

The following is a list of issues to consider for those who may be contemplating offering their own multi-site courses:

- Under a learner centered model, students need to assume a far greater responsibility for their learning. Besides choosing what and when to learn, they must become active questioners and investigators. Whatever the environment, it is important that students feel comfortable conducting an intellectual discussion or doing work.

- It is important to encourage participation and/or structure activities to get students involved in online discussion. Students need a clear understanding of what is expected of them and the objectives and outcomes of each assignment/activity. These needs are heightened in courses which are taught via a distance where nonverbal means of communicating is not possible.

- Faculty members need to remember they need to allow students to take ownership of class discussion and assume the role of the facilitator, not necessarily the "instructor."

- Planning and designing an effective distance course requires a significant amount of time and resources. For instance, faculty must develop meaningful projects/research opportunities for students in the local communities. In addition, funding for stipends needs to be secured for bringing "local experts/mentors" into the course.

- Lastly, institutionalization of the appropriate technology is imperative for the success of multi-site courses. Local centers need to have the technology (i.e., software, hardware, and connectivity), along with the local technical support, to participate in this type of course.

Stanford Overseas Studies views these first couple of courses as the first phase of its venture into the multi-site course format. Future plans involve the refining and possibly redefining the use of synchronous communication technology. There are also plans to branch out and offer more media rich courses, such as a photography course, in the multi-site course format.

In conclusion, new technologies for distance education have the potential to provide learning environments that can support active learning only if combined with shifts in teaching styles, content delivery, and learning activities. Curriculum design and technology integration are also essential. Curricula needs to be designed to take full advantage of the technology and go beyond the traditional delivery of knowledge model. Without these changes, Internet based courses are nothing more than correspondence courses conducted by email.

Reconstructing the Social Learning Theory: Social Presence Theory in Online Learning

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Abstract: Social presence is one of the most significant factors to examine in distance education. The impact of social presence on learning must be examined because of the prevalence of CMC in education. Many of the studies dealing with social presence on CMC have been done in standard educational settings and organizational settings. None of them have redefined social presence for CMC. This theory must be operationally understood and clearly defined before knowledgeable studies occur. The relationship between social presence and the social learning theory is also examined in this paper. Social interaction is fundamental to the explanation of this relationship. Social learning requires cognitive and environmental determinants, social presence is required to enhance and foster online social interaction, which is the major vehicle of social learning.

Introduction

Learning is a social process (Bandura, 1977; Tapscott, 1998). Primarily, knowledge is constructed through social conversation and dialogue; therefore, learners arrive at their own understanding of social experiences. Traditional media and face-to-face learning environments differ from an online community in the selections of delivery channels. Many educators have adopted the social learning theory (Bandura, 1977) and have applied it to the online learning environment. The existence of teachers' and students' social presence of has been taken for granted because of the characteristics of traditional media and face-to-face environments. Social presence in an online community requires more than computer-mediated communication (CMC) technologies. For instance, there is no presence at all if a person in an online community just observes and doesn't communicate. When one applies the social learning theory to an online learning environment, the level of social presence must be scrutinized. This discussion provides a new paradigm for the application of online social learning.

Scope of Social Presence

Social presence is defined as the degree of salience of another person in an interaction and the consequent salience of an interpersonal relationship [Short et al. 76; Rice 93; Walther 92]. Biocca [97] argued that social presence should be more complicated than just awareness. He defines, "the minimum level of social presence occurs when users feel that a form, behavior, or sensory experience indicates the presence of another intelligence. The amount of social presence is the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another." Factors that contribute to an appreciable degree of social presence are facial expression, direction of gaze, posture, dress, non-verbal, and vocal cues. Social presence was first hypothesized as an attribute of the medium itself [Short et al. 76], or technological social presence; however, this definition is not strictly accurate because several studies [Gunawardena 95b; Gunawardena & Zittle 97; Perse et al. 92] have shown that perception of the degree of social presence will vary among users. Social presence should be viewed as a subjective quality of the medium [Short et al. 76], although it depends upon the medium's objective quality (Technological Social Presence).

Social Presence Concepts in Social Psychology

Two concepts in social psychology are related to social presence: intimacy [Argyle & Dean 65] and immediacy [Wiener & Mehrabian 68].

Intimacy is a function of eye contact, proximity, topic of conversation; etc. changes in one will produce compensatory changes in the others [Short et al. 76]. A communication with maintained eye contact, close proximity, body leaning forward, and smiling conveys greater intimacy. Equilibrium theory [Short et al. 76] was an assumption to explain how humans balance the degree of intimacy. In a face-to-face setting, people tend to avoid maintained eye contact and increase physical separation if personal topics or topics with which a person is uncomfortable are to be discussed. People try to maintain an optimum level of intimacy. That is, when an uncomfortable degree of intimacy is encountered, the participants of the conversation will attempt to alter their behavior to maintain the degree of intimacy at an optimal level of comfort. The interaction is unpleasant if behavior cannot be altered to allow an optimal degree of intimacy. Short et al. [76] determined that very intimate tasks, those that are embarrassing, contain extremely personal content or areas of conflict, the medium lowest in social presence, the telephone, would receive a more favorable evaluation than face-to-face encounters or closed-circuit television. It can be concluded that the social presence of the communications medium should be included in the list of other factors contributing to intimacy, eye-contact, smiling, and personal topics of conversation [Argyle & Dean 65]. The levels of intimacy that people adopt are derived from cultural norms [Argyle & Cook 76] and from a need for affiliation [Walther 92]. Argyle and Cook [76] argued that the discussion topic might contribute to the level of intimacy. If someone is more familiar with the discussion topic, they feel more affiliated, or a greater intimacy.

The second psychological concept involved in social presence is immediacy. This is a measure of the psychological distance a communicator puts between himself or herself and the recipient of the communication. There are two forms of immediacy: technological immediacy is achieved when the maximum amount of information is transmitted [Heilbronn & Libby, 73]; and social immediacy, which is conveyed through speech and associated verbal and non-verbal, cues [Short et al. 76]. The user may alter social immediacy, while technological immediacy is an inherent characteristic. One can generate immediacy or non-immediacy nonverbally [physical proximity, formality of dress, and facial expression] and verbally [Gorham 88]. CMC users normally will use paralanguage or emoticons to substitute for the missing cues, such as "I agree" for head nodding, and ":-)" for smiling, etc. because non-verbal cues cannot be delivered on CMC. Rice and Love [87] found that socio-emotional contents constitute one third of the total messages on a bulletin board. Gunawardena [95] argues that immediacy enhances social presence; therefore, the degree of social presence is not only an attribute of the medium. Increasing the intensity of immediacy can enhance social presence.

Degree Of Social Presence

Degree of social presence is based upon the characteristics of the medium and the user's perception. That is, the social presence factor is a dynamic variable. Different people discern different amounts of social presence in different media. People, in fact, anthropomorphize computers and treat them as "social actors" [Reeves & Nass 96]. Hence, social presence is the internal image the perceiver evokes of a moving, expressive body. This concept is similar to Goffman's [59] "self-presentation." Normally, the users are asked to measure the degree of social presence [Perse et al. 92]. Short et al. [76] measured social presence through the semantic differential technique with a series of seven-point, bipolar scales, such as sociable/unsociable, personal/impersonal, sensitive/insensitive, and warm/cold.

Social presence may actually be taught or cultured [Johansen et al. 88]. Users have substantial opportunities to modify social presence by varying message qualities [Short et al. 76]. Social presence can be cultured by teleconference leaders or encouraged by initial learning sessions [Johansen et al. 88]. Gunawardena's study [95b] suggested that it is an instructor's interaction skills and techniques that will impact the student's perception of social presence. Consequently, instructors, or moderators, should develop interaction skills that create a sense of social presence.

Three Dimentions of Social Presence

Social presence has three dimensions: social context, online communication, and interactivity. Each dimension is discussed below:

Social context contributes to the degree of social presence, such as task orientation [Steinfield, 86], privacy [Steinfield, 86], topics [Walther 92], recipients/social relationships [Williams & Rice, 83], and social process [Walther, 92] etc. Walther [92] proposed that different social processes, settings, and purposes are components of social context and affect social presence.

Task types influence the degree of social presence, and communication processes. Four different task types were proposed [Hollingshead & McGrath, 95]: (a) group generation of ideas or plans, (b) selecting among answers or solutions, (c) negotiation of conflicting views or conflicting interests, and (d) execute performances in competition with opponents or external standards. Steinfield [86] studied the organizational use of e-mail in different settings. He found that task complexity, task interdependence, environmental uncertainty, and the need for communication across distant locations were positively associated with increasing task orientation in CMC messaging. In fact, Walther's three variables, social process, purpose, and setting, form the "Social Context" dimension of the three dimensions of social presence [social context, communication, and interactivity] discussed earlier in this paper. Walther [92] argued that social relationships would stimulate changes in interactions. CMC systems tend to have less relational communication initially. However, as time passes, CMC users are driven to develop social relationships by forming impressions of others through the information conveyed by text-based CMC. It was concluded that participants became more social toward the latter part of a CMC conference than during the initial stages and exchanged more personal messages [Gunawardena & Zittle 97]. Relational history also has an impact on social relationships.

Perception of privacy, one component of social context, affects the degree of social presence. A less private setting results in a decreased perception of social presence by users. In an experimental study, Champness [72] reported that users felt more public in a videoconference and perceived less social presence. Videoconferencing created a psychological sense of intrusion rather than a feeling of security. Generally speaking, a camera in operation may be seen as intrusive, or attitudes toward the use of TV in public broadcasting may carry over into the laboratory, concerns of electronic eavesdropping exist and produce consequent negative reactions [Ryan, 76]. Steinfield [86] examined the social presence of e-mail in organizational settings. He reported that users were reluctant to employ e-mail for confidential matters, so this perception of privacy may not have affected their use of e-mail. The privacy characteristics of other CMC systems, 'one to one' CMC may be seen as more private, while 'one to many' CMC (listserv and bulletin board) may be viewed as more public. Therefore, the user's perception of privacy on different CMC systems deserves further investigation.

Online communication is the exchange of thoughts, messages, or information that occurs online. Because of the technology and its text-based format, computer-mediated communication requires that uses possess some level of computer communication literacy such as typing, reading and writing. People who are unable read or write well [or who believe they cannot] or have limited typing skills will become the computerized society's new "handicapped" group [Phillips 83]. People in this situation develop communication anxiety [Gunawardena 91] when text-based communication is required. Therefore, it is suggested that text-based communications should be initiated with some light or casual topics, like introductions. Training students to use the medium and making them comfortable using it is crucial to the success of collaborative learning. Garramone et al. [86] and Perse et al. [92] examined students' perceptions of social presence and concluded that the degree of social presence on computer bulletin boards was perceived as higher for users who were more interactive than for those who were not. Perse et al. [92] found a positive relationship between social presence and the student's perception of their own computer expertise.

Interactivity, defined as the ability to convey a two-way exchange and the potential of an immediate response, contributes to social presence [Williams & Rice 83]. The potential for feedback from the other also contributes to the degree of salience of the other person in the interaction. Immediate response is another component of interactivity. In asynchronous CMC response occurs at a different time, so it takes longer to obtain a response from the other party. When an immediate response is expected and is not received a feeling of low interactivity is created, thus decreasing the level of social presence. However, Garramone et al. [86] found that interactivity, allowing for feedback, contributes to the social presence of an electronic bulletin board. Gunawardena [95b] differentiates interactivity and social presence, arguing that social presence requires user's to add one more step to awareness of interactivity; in short, when users notice it, there is social presence.

Social Learning Theory

Bandura's [77] social learning theory states that neither inner forces [person] nor environmental stimuli [environment] drive people as isolated influences. Behavior and complex learning must be "explained in terms of a continuous reciprocal interaction of personal environmental determinants...virtually all learning phenomena resulting from direct experience occurs on a vicarious basis by observing other people's behavior and its consequences for them" [p. 11, 12]. From this point of view, it can be concluded that human behaviors are affected by observation and by direct experience.

The social learning theory emphasizes that behaviors result from the social interaction of people and their environments, rather than from either factor alone [Bowers 73]. That is, personal and environmental factors do not function as independent determinants, rather they determine each other, and the influences are bi-directional. Consequently, the social learning theory approaches the explanation of human behavior in terms of a continuous reciprocal interaction between cognitive, behavioral, and environmental determinants.

The social learning theory views interaction as a process of reciprocal determinism; behavior, other personal factors, and environmental factors all operate as interlocking determinants of each other. Generally, there will be no initiation of social leaning at all if the model is unable to be perceived as socially present by the learners. Also, social interaction between learners and teachers/role models is required for social learning to occur. No interaction, no learning [Gunawardena 95a]. Social interaction on CMC is affected by some degree of social presence. Learners must acknowledge and value the other person's social presence; otherwise, social interaction is absent and social learning will not occur. Therefore, behavior, personal factors, and ideal social learning environment can be created and promote learning on CMC with an appropriate degree of social presence. If the degree of social presence is low, social interaction, which is the foundation of social learning, does not occur.

Processes of Observational Learning

Four processes of observational learning are proposed to explain the social learning model [Bandura 77]: (a) observation of the relevant activities, (b) coding of the modeled events for memory representation, (c) retention of what was learned, and (d) generating sufficient incentive to learn. The importance of social presence in observational learning emerges, particularly in an environment without context cues. Social learning behaviors, when social presence is not appreciated, can be very different from what is expected. Learning is avoided by not observing the relevant activities; inadequately coding modeled events for memory representation, failing to retain what was learned, or experiencing insufficient incentives.

Observational learning requires that learners notice the significant features of the model's behavior [Bandura 77]. This particular attention to models occurs in the interpersonal attraction/relation, which is primarily influenced by the degree of social presence in the CMC setting [Walther 97]. The learner must be presented with an optimized social presence. Learners in some face-to-face circumstances are unable to build interpersonal attraction with the models because of unequal participation, cultural and personal reasons. Murfin [94] found that female and minority students responded with less anxiety and better interpersonal relationships to learning science subjects with scientists as models on CMC. This occurred because the students perceived a higher degree of social presence.

Information retention and information recall are required in observational learning to produce symbolic representation (imitation) [Bandura 77]. Instantáneous imitation doesn't require much cognitive functioning; but delayed modeling requires the learner to possess better cognitive functioning and information recall. This is particularly true in asynchronous CMC environments because of the time-delayed nature. Social presence with a prevalent degree of immediacy has a very positive influence upon cognitive learning [Gorham 88]. Kelley and Gorham [88] examining teacher immediacy, a psychological component of social presence, found that teacher immediacy produced positive results on information recall. That is, higher teacher immediacy, higher social presence will support the retentional process of social learning. Social presence appears to enhance delayed modeling.

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The third process requires transforming information from symbolic representation to appropriate actions. Cognitive organization, an essential element in this process, will help the learner to integrate the skills learned through observation, if absent the reproduction behavior will be "faulty" [Bandura 77]. Therefore, this process also requires a higher degree of social presence to increase the learner's cognitive learning and information recall and allow production of the expected modeling behavior. Learners of social behaviors only reproduce those behaviors they value. The incentives, delivered verbally or non-verbally, are critical to motivating the learner. These incentives are delivered with difficulty in the CMC setting if the person is unfamiliar with using emoticons or paralanguage to enhance social presence.

Vygotsky's Social Development Theory

Vygotsky's social development theory [78], complementary to Bandura's work on social learning, is a key component of the situated learning theory. Vygotsky believed that full cognitive development requires social interaction. Social interaction plays a fundamental role in the development of cognition. The primary theme of Vygotsky's [78] theoretical framework is that, "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people [interpsychological] and then inside the child [intrapsychological]. This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals" [p. 57]. Learner's awareness as the end product of socialization was addressed by this developmental theory. For example, in the learning of language, children's first utterances with others are for the purpose of communication, when they are mastered they become internalized and allow inner speech.

Social interaction is a key component in social learning according Vygotsky's theory. CMC has been found to be primarily devoted to social interaction [Reid 91], and it even outperformed a face-to-face group in social interaction because of a higher degree of social presence being perceived by users [Walther 95]. In the distance education setting, participants agreed that there were many social and personal interaction messages sent because of the high degree of social presence created by the teacher/moderator enhancing the social interaction, thereby increasing social learning [Gunawardena & Zittle 97].

Conclusion

Social presence is one of the most significant factors to examine in distance education. The social presence theory was proposed and examined in face-to-face, audio-conferencing, and videoconferencing environments. It was not, originally, proposed for computer-mediated communication technology, the newest education technology for distance education. The impact of social presence on learning must be examined because of the prevalence of CMC in education. Many of the studies dealing with social presence on CMC have been done in standard educational settings and organizational settings. None of them have redefined social presence for CMC. This theory must be operationally understood and clearly defined before knowledgeable studies occur.

The relationship between social presence and the social learning theory is also examined in this paper. Social interaction is fundamental to the explanation of this relationship. Social learning requires cognitive and environmental determinants, social presence is required to enhance and foster online social interaction, which is the major vehicle of social learning.

References

Argyle, M., & Cook, M. (76). Gaze and mutual gaze. Cambridge, MA: Cambridge University Press.
Argyle, M., & Dean, J. (65). Eye contact, distance and affiliation. Sociometry, 28, 289-304.
Bandura, A. (77). Social learning theory. Englewood Cliffs, NJ: Prentice-Hall.
Biocca, F. (97). The Cyborg's dilemma: Embodiment in virtual environments. In Keynote talk at the Second Cognitive Technology Conference. [WWW Document], http://commtechlab.msu.edu/MIND/cyborg/cyborg.html.
Bowers, K. S. (73). Situationism in psychology: An analysis and a critique. Psychological Review, 80, 307-336.
Champness, B. G. (72). Attitudes towards person-person communications media. University College, London: Unpublished

BEST COPY AVAILABLE

Communications Studies Group Paper No. E/72011/CH.

Durlak, J. T. (87). A typology for interactive media. In M. L. McLaughlin (Ed.), Communication yearbook 10, (pp. 743-757). Newbury Park, CA: Sage.

Garramone, G. M., Harris, A. C., & Anderson, R. (86). Uses of political computer bulletin boards. Journal of Broadcasting & Electronic Media, 30(3), 325-339.

Goffman, E. (59). The presentation of self everyday life. New York: Doubleday.

Gorham, J. (88). The relationship between verbal teacher immediacy behavior and student learning. Communication Education, 37(1), 40-53.

Gunawardena, C. N. (91). Collaborative learning and group dynamics in computer-mediated communication networks. Research Monograph No.9 of the Second American Symposium on Research in Distance Education. (pp. 14-24). University Park, PA: Pennsylvania State University: American Center for the Study of Distance Education.

Gunawardena, C. N. (95a). Interaction - Affirmative. (Opening Statement). ICDE95: Debate on Interaction. [WWW Document], http://www.ualberta.ca/~tanderso/icde95/interaction_www/0009.html.

Gunawardena, C. N. (95b). Social presence theory and implications for interaction collaborative learning in computer conferences. International Journal of Educational Telecommunications, 1(2/3), 147-166.

Gunawardena, C. N., & Zittle, F. J. (97). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. The American Journal of Distance Education, 11(3), 8-26.

Heilbronn, M., & Libby, W. L. (73). Comparative effects of technological and social immediacy upon performance and perceptions during a two-person game. Proceedings of the Annual Convention of the American Psychological Association.

Hollingshead, A. B., & McGrath, J. E. (95). The whole is less than the sum of its parts: A critical review of research on computer-assisted groups. In R. A. Guzzo, & E. Salas (Eds.), Team effectiveness and decision making in organizations (pp. 46-78). San Francisco, CA: Jossey-Bass.

Johansen, R., Vallee, J., & Spangler, K. (88). Teleconferencing: Electronic group communication. In R. S. Cathcart, & L. A. Samovar (Eds.), Small group communication: A reader. (5th ed., pp. 140-154). Menlo Park, CA: Institute for the Future

Kelley, D. H., & Gorham, J. (88). Effects of immediacy on recall of information. Communication Education, 37(3), 8-207.

Murfin, B. (94). An analysis of computer-mediated communication between middle school students and scientist role models. Interpersonal Computing and

Perse, E. L., Burton, P., Kovner, E., Lears, M. E., & Sen, R. J. (92). Predicting computer-mediated communication in a college class. Communication Research Reports, 9(2), 161-170.

Phillips, A. F. (83). Computer conferences: Success or failure. In R. N. Bostrom (Ed.), Communication yearbook 7, (pp. 837-856). Beverly Hills, CA: Sage.

Reeves, B., & Nass, C. (96). The Media Equation: How people treat computers, television, and new media like real people and places. Stanford, CA: CSLI Publications.

Reid, E. (95). Virtual worlds: Culture and imagination. S. G. Jones (Eds.), Cybersociety, (pp. 164-183). Newbury, CA: Sage.

Rice, R. E. (93). Media appropriateness: Using social presence theory to compare traditional and new organization media. Human Communication Research, (4), 451-484.

Rice, R. E., & Love, G. (87). Electronic emotion: Socioemotional content in a computer-mediated network. Communication Research, 14, 85-108.

Ryan, M. G. (76). The influence of teleconferencing medium and status on participants' perception of the aestheticism, evaluation, privacy, potency, and activity of the medium. Human Communication Research, 2, 255-261.

Short, J., Williams, E., & Christie, B. (76). The social psychology of telecommunications. London: John Wiley & Sons, Ltd.

Steinfield, C. W. (86). Computer-mediated communication in an organizational setting: Explaining task-related and socioemotional uses. In M. L. McLaughlin (Ed.), Communication yearbook 9 (pp. 777-804). Newbury Park, CA: Sage.

Tapscott, D. (1998). Growing up digital: The rise of the net generation. New York: MvGraw-Hill.

Vygotsky, L. S. (78). Mind in society . Cambridge, MA: Harvard University Press.

Walther, J. B. (97). Group and interpersonal effects in international computer-mediated collaboration. Human Communication Research, 23(3), 342-369.

Walther, J. B. (92). Interpersonal effects in computer-mediated interaction: A relational perspective. Communication Research, (1), 52-90.

Walther, J. B. (95). Relational aspects of computer-mediated communication: Experimental observations over time. Organization Science, 6(2), 186-203.

Wiener, M., & Mehrabian, A. (68). Language within language: Immediacy, a channel in verbal communication. New York: Appleton-Century-Crofts.

Williams, F., & Rice, R. E. (83). Communication research and the new media technologies. In R. N. Bostrom (Ed.), Communication Yearbook 7, (pp. 200-224). Beverly Hills, CA: Sage.

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Integrating Online Interaction into Computer-Mediated Communication

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Abstract: CMC can enhance and inhibit interactions in distance education and communication. Characteristics of CMC, the design and use of instruction and the users' perception of the medium are critical points to be considered when utilizing CMC to enhance online interaction. Increasing all four types of interactions requires a thorough understanding of the strengths and weaknesses of each CMC system and the users (students and teachers) to integrate CMC technology into a virtual classroom.

Introduction

Interaction is a crucial component for learners, teachers, and researchers to examine. No interaction, no learning [Gunawardena 95]. Garrison [93] states that the "concern for quality in distance education has identified an emerging paradigm based upon two-way communication as a necessary and central component of an educational transaction" [p. 17]. In other words, interactive (two-way) communication is the critical component in distance education.

Computer-mediated communication technologies have been utilized in every learning situation, including traditional environments and distance delivery. The attributes of the computer technologies themselves do not change with use; the critical issue is how we integrate this new technology into classrooms. In other words, how humans interact with the technologies and how humans perceive the technologies will have major impacts on learning interaction processes. Many studies have concluded that technology-based instruction has positive impacts on interaction. However, few of them examine the negative impacts on interaction. To provide better utilization of computer-mediated communication, both positive and negative aspects must be examined thoroughly to provide a better understanding of relationships of CMC and interaction. This paper provides a comprehensive discussion on how interaction is increased or inhibited when integrating CMC into instruction based on four different CMC systems (e-mail, bulletin board, listserv, and real-time chat) within four different interactions, learner-learner, learner-teacher, learner-content, and learner-interface. CMC technologies in a distance education setting can be classified as synchronous (real time communication) or asynchronous (time-delayed communication) systems. Audio and video conferencing systems are not included in this discussion.

CMC Enhance Interactions

Appropriate instructional design of CMC based education enhances online interactions among students, teachers, content and interface.

Less Participating Students

Cyberspace allows one to have anonymity and multiple identities, also one can shift identities rather easily, taking on characteristics of others' identities. Users may feel anonymous, although using their real names, because they might pass their computer-conversation partners on the street without being recognized. Phillips [83] argued that the chance to speak anonymously could lead to the expression of honest opinion and to candidness of emotional comments. In fact online users tend to judge one's mind rather than their appearance, race, accent, etc. The online user is physically alone with the terminal attached to a telephone. The idea of "being alone with one's terminal" may lead to a reduction of barriers and a relaxation of face-maintaining behavior [McBride & Bazley 97].

Garramone et al. [86] conclude that the aloneness and the anonymity of CMC may encourage online users to connect more intimately to others in society.

Hartman et al. [91] insist that anonymity can give shy, critical, and considerate people the opportunity to comment without personal repercussions. The idea of being alone with one's terminal may lead to a letting down of barrier and face-maintaining behavior. Students who normally feel shy in a classroom setting often feel more comfortable, and less embarrassment, communicating electronically with the instructor and other students [Hoare & Race 90]. Interaction among instructors and students can be enhanced because students can reiterate or ask follow-up questions without the concern that their questions will be naïve [Manning 96].

Expression Equality

CMC has been described as a venue where participants can participate in discussions on bulletin boards and listservs equally [Sproull & Kiesler 91]. Van Gelder [90] referred to CMC as "egalitarian." The democratic openness of the computer conference environment allows all students an opportunity to contribute. Harasim [96] described the possibility "…for anyone to become an information provider for others, thereby both democratizing information access and enabling new roles for network users. In the most successful online courses, students assume some of the roles that traditionally belong to the instructor" [p. 208]. Democratic openness, the absence of nonverbal status cues, teacher-student role reversal, and learner-to-learner interaction within a CMC environment provide an opportunity for a more equal platform for communication and more stimulus for action than does a traditional classroom [Sproull & Kiesler, 91].

One-to-Many Communication

Listserv is a one-to-many communication that fosters online interaction among students and instructors. Many distance courses utilize listservs for class discussion. A number of studies have examined the use of listservs in this setting. Blocher [97] reported that students rated the listserv as having the highest ability for interaction with peers because of its one-to-many nature. Piburn and Middleton [97] also found that the listserv has generated an increasing volume of correspondence on a wide variety of topics. Some students have recognized the interaction as a means of collecting relevant articles and other tidbits of information. The students initiate the conversations, thus, reversing their roles with the teachers, the teachers answer questions, and the students react. This process increases learner control. Long and complex conversations develop on listservs, as students explore their developing understandings of both content and pedagogy that enhance learner-content interaction as well.

Listserv tends to be more readily available than bulletin boards. The listserv messages come to users' e-mail accounts, unlike bulletin boards, which require users to visit the board to retrieve the messages. As long as users check e-mail messages regularly, listserv users can be reached more easily than bulletin board members can; but the bulletin board provides better learner-interface interaction because of message threading.

Access-Availability

Accessibility and availability of CMC augment interaction among learners, teachers, and content. Internet instruction with hypertext is available continuously where ever there is Internet access. Students are able to access the content any time and anywhere. Kahn and Brookshire [91] integrated a computer bulletin board in a social psychology course; the bulletin board expanded the learner-teacher interaction as well as interaction among students, and it allowed students have easier access to their instructors. Hoare and Race [90] reported a similar finding that class discussion on a bulletin board could continue around the clock because students are free to enter comments any time that the computer system is available. The longer period of time allows greater student access to instructors and may increase learner-instructor interaction.

Collaboration and Student Publishing

Computer conferencing supports collaboration among learners, instructors (experts), content, and media. The learning and interaction that occur in environments that employ CMC encourage collaboration and teamwork and require active rather than passive participation. Blocher [97] argued that peer collaboration requires positive interaction and provides learners with dialogue that can help clarify confusing course material as well as grasp understandings that might go beyond the individual's conceptions. Good management of peer learning also includes making intelligent choices in selecting a peer. Collaboration should not be limited to peers only, computer conferencing supports the individual through a social network of peers as well as the instructor via collaboration and teamwork in which participants share the roles of both expert and novice [Harasim 96]. Through a computer conferencing system one collaborative group can link with other collaborative groups with similar projects both nationally and internationally, access experts or communities of practice, access resources and network with peers [Harasim 98].

Student publishing via CMC is another method of increasing learner-leaner interactions, leaner-content interactions, and the quality of the interactions in a technology based learning environment. Jonassen [96] argued that when learners have a wider audience for their writing or other scholarly activities, they tend to invest more effort in the process and learn more because there are more learner-learner and learner-content interactions involved. Cohen and Reil [89] found that assignments written to communicate with peers by using an electronic bulletin board and e-mail were more fluent, better organized, and clearer than those that were written merely for grades. Authoring newspapers and booklets collaboratively by collecting articles from partner schools around the world by using bulletin board and e-mail results in better use of grammar and syntax [Riel 90]. Student publishing also can be taken one step further by using an online database [Tu 99] to increase learner-content interaction and to enhance students' knowledge construction. Jonassen et al. [95] argued that in a distance education environment, remote access to online databases facilitate the construction of knowledge. Retrieved information can be used to support positions in a computer conference discussion, for elaboration on a particular topic, or for satisfying personal curiosity. Turning students' works into searchable databases can attain the construction of knowledge.

Time Delay

Asynchronous CMC tools, such as e-mail, bulletin board, or listserv, provide more time for students to reflect on their communication. The time delay allows students to prepare their comments and assignments more carefully, a definite advantage when English is a second language, as well as reducing the student's anxiety during examinations [Johnston 84]. This ability may afford users enhanced opportunities for selective self-presentation, rendering qualitatively different interpersonal impressions than they might convey in synchronous CMC or face-to-face communication. Students can take advantage of the time delay inherent in the asynchronous CMC systems to reflect and compose coherent responses. A study on the use of e-mail in a reading education class [Anderson & Lee 95] has shown that reflective thinking does occur among students in e-mail interactions.

CMC Inhibit Interactions

The attributes of CMC with an inappropriate instructional design are likely to inhibit online interactions among students, teachers, content and interface.

Less Computer Literacy Skill

Literacy skills are required to achieve desired activities and goals when CMC is integrated into the classroom. These computer literacy skills include keyboarding skills, reading skills, writing skills, and general computer operation skills [Perse et al. 92]. People who cannot read or write well (or who believe they cannot), or type will become the computerized society's new "handicapped" group [Phillips 83]. The nature of CMC is currently grounded in its emphasis on English writing skills because of its text-based orientation. The text-based character of CMC is an important issue for individuals of foreign origin. Communication written with a keyboard can be used as an ideologically charged tool for either cultural domination or cultural survival [McLaughlin 91]. For cultures that have historically transmitted their teaching through oral traditions, such as Native Americans [Baldwin 95], and have been introduced to a typing keyboard, such as Asian students, the use of English text introduces a huge disadvantage for the student and inhibits interactions. Computer literacy skills apply to students as well as instructors or moderators. They should have the ability to resolve hardware and software problems encountered which affect the online discussion and create anxiety.

Privacy

The issue of privacy affects the social psychology of telecommunication. The debate regarding the private/public aspect of online communication is a major issue that deserves further scrutiny. All CMC systems are considered public [Witmer 97]. Computer teleconferencing should remind the online user of the spectrum of electronic surveillance and the negative impact eavesdropping produces on interactions. More than a third of the online users responded with the statements that "information can come into the wrong hands" and "outsiders can see private messages" [Kerr & Hiltz 82]. The communications and activities of an online course are largely public if the course is structured for collaborative learning and the students examine each other's work. This is very critical when the discussion topic is sensitive or personal. Some users are aware of this, while others are not. Steinfield [86] found that users were reluctant to employ electronic mail for confidential matters. Users generally perceive e-mail as not being private. When an environment is perceived as public, interaction and communication are curtailed. The public nature of a virtual classroom will have a negative impact on student learning.

Impersonal

De-individuation occurs when people have anonymity or when the situation lacks societal cues, mores and values [Sproull & Kiesler 91]. According to Kiesler [86], "without nonverbal tools, a sender cannot easily alter the mood of a message, communicate a sense of individuality, or exercise dominance or charisma.... Communicators feel a greater sense of anonymity and detect less individuality in others" [p. 48]. Saunders and Heyl [88] reported that some students complain about the disjointed nature of dialogue on computer conferencing systems. Recent studies have found that CMC technologies are not inherently personal or impersonal [Walther 96]. The amount of interaction among learners and instructors is inhibited if the communicators are technologically inexperienced, and if they are unable to emphasize the special stylistic [Sallinen-Kuparinen 92] and persuasive strategies required or if the teacher/moderator is unable to create a sense of social presence.

Longer Process

Both synchronous and asynchronous CMC systems tend to take longer process than face-to-face communication. There are data that demonstrate that CMC groups took longer to reach a decision than face-to-face groups; some CMC groups even failed to achieve consensus at all within the allotted time [Gunawardena & Zittle 97]. Walther [96] argues that on a CMC system interpersonal effects normally occur more slowly. Gunawardena and Zittle [97] examined this nature of CMC, and reported agreement among participants that there were more social and personal messages toward the latter part of a CMC conference than during the initial stages, because student responses are longer and more complex than those created through face-to-face discussion. This may discourage many online learners and produce a negative impact on interaction, particularly in e-mail, bulletin board, and listserv settings. Due to the time delay experienced in asynchronous CMC discussions; participants may have difficulty maintaining a clear impression about the topics being discussed.

Communication Style and Domination

Personal communication style may have a negative impact on interaction, if one is not familiar with the written online communication style [Bazerman 94]. Gunawardena and Zittle [97] concluded that instructors who rely on nonverbal cues to provide feedback, and who have a lesser-developed ability to project their personality, would need to learn to adapt to CMC media by developing skills that create a sense of social presence. Being unfamiliar with online communication style will negate the socio-emotional sense and cause participants to sense a lower degree of social presence thus inhibiting learner-learner and learner-instructor interactions. Therefore, online users, teachers and students, must learn how to use "emoticons" to express the missing non-verbal cues in text-based CMC systems.

Although CMC systems have been found to provide equal participation for online learners [Gunawardena & Zittle 97], opposite findings have been reported. Domination of the discussion on CMC could have a negative impact on interactions. Selfe and Meyer [91] found evidence that men and high status participants dominate e-mail discussions. Herring [94] observed that in mixed-gender discussion lists men seemed to do most of the talking, attracting attention to themselves, although not all men were as adversarial as they were vocal; but, she found men often dominate discussions even when the topics were female oriented.

Uninhibited Behavior

Uninhibited behavior may have negative impact on interaction. Although "flaming" behavior is rare in the CMC environment [Lea et al. 92], insinuating and offensive messages can be spread easily in some newsgroups. CMC users are able to create multiple identities and socialize with different people with both pseudo and real identities at the same time. The user's self-awareness is reduced and inhibited behavior results. A number of researchers [Lea & Spears 91] focused on the perception of the medium it appears that a writer's relation to a screen and electronic communication seems different from a writer's relation to a written letter or memorandum. Writing on a screen will cause communicators to lose the sense of an audience, become self-absorbed, and lose the constraints and inhibitions that the imagined audience provides. Therefore, roles become less clear, and it is difficult to discern who is producing information for whom [Vian & Johansen 81]. This false sense of anonymity that students feel when using e-mail prompts some to send messages electronically that they would never dare say in a face-to-face interaction [Manning 96].

Conclusion

Computer-mediated communication can enhance and inhibit interactions in distance education and communication. Characteristics of CMC, the design and use of instruction and the users' perception of the medium are critical points to be considered when attempting to utilize CMC to enhance online interaction. Integrating CMC into classrooms requires an understanding of the relationship between CMC, the learners, and the instructors. Increasing all four types of interactions requires a thorough understanding of the strengths and weaknesses of each CMC system and the users (students and teachers) is necessary to integrate CMC technology into a virtual classroom.

References

Anderson, J., & Lee, A. (95). Literacy teachers learning a new literacy: A study of the use of electronic mail in a reading education class. Reading Research and Instruction, 34(3), 222-238.

Baldwin, G. D. (95). Computer-mediated communication and American Indian education. In Z. L. Berge, & M. P. Collins Computer mediated communication and the online classroom volume 1: Overview and perspectives. (pp. 113-136). Cresskill, NJ: Hampton Press, Inc.

[Bazerman, C. (94). Constructing experience. Carbondale-Edwardsville, IL: Southern Illinois University Press.

Blocher, J. M. (97). Self-regulation of strategies and motivation to enhance interaction and social presence in computer mediated communication. Unpublished doctoral dissertation, Arizona State University, Tempe, AZ.

Cohen, M., & Riel, M. (89). The effect of distant audiences on students' writing. American Educational Research Journal, 26(2), 143-159.

Garramone, G. M., Harris, A. C., & Anderson, R. (86). Uses of political computer bulletin boards. Journal of Broadcasting & Electronic Media, 30(3), 325-339.

Garrison, D. R. (93). Quality and access in distance education. In D. Keegan (Ed.), Theoretical principles of distance education. (pp. 9-21). New York: Routledge.

Gunawardena, C. N. (95). Social presence theory and implications for interaction collaborative learning in computer conferences. International Journal of Educational Telecommunications, 1(2/3), 147-166.

Gunawardena, C. N., & Zittle, F. J. (97). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. The American Journal of Distance Education, 11(3), 8-26.

Harasim, L. M. (98). The internet and intranets for education and training: a framework for action. In C. de Moura Castro (Ed), Education in the information age. (pp. 181-201). Washington, DC: Inter-American Development Bank.

Harasim, L. M. (96). Online education: The future. In T. M. Harrison, & T. Stephen (Eds.), Computer networking and scholarly communication in the twenty-first-century university. (pp. 203-214). New York: SUNY Press.

Hartman, K., Neuwirth, C. M., Kiesler, S., Sproull, L., Cochran, C., Palmquist, M., & Zubrow, D. (91). Patterns of social interaction and learning to write. Written Communication, 8(1), 79-113.

Herring, S. (94). Gender differences in computer-mediated communication: bringing familiar baggage to the new frontier. In Keynote talk at panel entitled "Making the Net'Work': Is there a Z39.50 in gender communication?".

Hoare, R. M., & Race, W. P. (90). Computer conferencing: A versatile new undergraduate learning process. SIGUCCS Newsletter, 20(2), 18-24.

Johnston, J. (84). Commentary on issues and concepts in research on computer-mediated communication systems. In J. E. Anderson (Ed.), Communication yearbook 12. (pp. 490-497). Newbury, CA: Sage.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Hagg, B. B. (95). Constructivism and computer-mediated communication in distance education. The American Journal of Distance Education, 9(2), 7-26.

Jonassen, D. H. (96). Computers in the classrooms: Mindtools for critical thinking. Englewood Cliffs, NJ: Prentice Hall.

Kahn, A. S., & Brookshire, R. G. (91). Using computer bulletin board in a social psychology course. Teaching of Psychology, 18, 245-249.

Kerr, E. B., & Hiltz, S. R. (82). Computer-mediated communication systems: Status and evaluation. New York: Academic Press.

Kiesler, S. (86). The hidden messages in computer networks. Harvard Business Review, 64, 46-57, 58-90.

Lea, M., O'Shea, T., Fung, P., & Spears, R. (92). 'Flaming' in computer-mediated communication: observation, explanations, implications. In M. Lea (Ed.), Contexts of computer-mediated communication. (pp. 89-112). New York: Harvester Wheatsheaf.

Lea, M., & Spears, R. (91). Computer-mediated communication, de-individuation and group decision-making. International Journal of Man Machine Studies, 34, 283-301.

Manning, L. M. (96). Economics on the Internet: Electronic mail in the classroom. Journal of Economic Education, 27(3), 201-204.

McBride, N. K., & Bazley, M. (97). Threads of conversation: The life of a public e-mail conference . Paper presented at the 5th European Conference on Information Systems. [WWW Document], http://www.nmsi.ac.uk/education/paper.htm

McLaughlin, D. (91). Curriculum for cultural politics: Literacy program development in a Navajo School setting. In R. L. Jr. Biomeyer, & C. D. Martin (Eds.), Case studies in computer aided learning. (pp. 151-164). London: The Falmer Press.

Perse, E. I., Burton, P., Kovner, E., Lears, M. E., & Sen, R. J. (92). Predicting computer-mediated communication in a college class. Communication Research Reports, 9(2), 161-170.

Phillips, A. F. (83). Computer conferences: Success or failure. In R. N. Bostrom (Ed.), Communication yearbook 7. (pp. 837-856). Beverly Hills, CA: Sage.

Piburn, M. D., & Middleton, J. A. (97). Listserv as journal: Computer-based reflection in a program for preservice mathematics and science teachers. Paper presented at the International Conference on Science, Mathematics and Technology Education. (ERIC Document Reproduction Service No. ED 404 330).

Riel, M. (90). Cooperative learning across classrooms in electronic learning circles. Instructional Science, , 445-466.

Sallinen-Kuparinen, A. (92). Teacher communication style. Communication Education, 41, 153-166.

Selfe, C. L., & Meyer, P. R. (91). Testing claims for online conferences. Written Communication, 8(2), 163-2.

Sproull, L. S., & Kiesler, S. (91). Connections: New ways of working in the networked organization. Cambridge, MA: MIT.

Steinfield, C. W. (86). Computer-mediated communication in an organizational setting: Explaining task-related and socioemotional uses. In M. L. McLaughlin (Ed.), Communication yearbook 9 (pp. 777-804). Newbury Park, CA: Sage.

Tu, C. H. (99). Database, Collaborative Learning, and Internet. Proceedings of the annual meeting of Society for Information Technology and Teacher Education International Conference.

Van Gelder, L. (90). The strange case of the electronic lover. In G. Gumper, & S. L. Fish (Eds.), Talking to stranger: Mediated therapeutic communication. (pp. 128-142). Norwood, NJ: Ablex Publishing.

Vian, K., & Johansen, R. (81). Knowledge synthesis and computer-based communication system: Changing behavior and concepts. Paper prepared for National Institute of Education: Project on Knowledge Synthesis and Interpretation. (ERIC Document Reproduction Service No. ED 206 265).

Walther, J. B. (96). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. Communication Research, 23(1), 3-43.

Witmer, D. F. (97). Risky business: Why people feel safe in sexually explicit on-line communication. Journal of Computer Mediated Communication, 2(4)[WWW Document], http://www.ascusc.org/jcmc/vol2/issue4/witmer2.html

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Integration of Narrowband (Internet) and Broadband (TV) Satellite Technologies for Teaching and Learning

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Abstract: This paper describes a project funded by the commonwealth of Pennsylvania, Link-to-Learn technology testbeds. The purpose of this project was to design, develop, implement, and evaluate a hybrid information delivery system that integrates the broadband capabilities of direct broadcast satellite (DBS) and the peer to peer attributes of narrowband Internet technologies. The hybrid system was designed to integrate networked, broadcast, digital, interactive and multimedia technologies for delivery of media rich content to targeted users. This project demonstrated the use of these technologies in selected K-12 classrooms and community agencies in the Lehigh Valley of eastern Pennsylvania.

1. Introduction

The emergence of Internet technology as a transport for distributing and accessing teaching and learning resources has provided opportunities to create new and unique learning environment. Riley [Riley 1998], U.S. Secretary of Education, acknowledged this phenomenon by pointing out in his speech that connecting every school in America to the Information Superhighway, and helping every teacher develop the tools and skills they need to enhance student learning through technology are two of the goals of the technology literacy challenge for the U.S. Department of Education in the 21st century. However, limited bandwidth of the Internet is one of the obstacles that currently hinders the quality and speed of instructional materials delivered over the Internet. In addition to limited bandwidth, many of rural areas do not have the infrastructure to provide the Internet access.

For educational purposes, data transmission speed and bandwidth are crucial to high quality educational materials delivered via the Internet. Conventional LAN based network may provide the transmission speed needed, however, it is sometimes too costly for some schools who are not able to afford to implement or even impractical for the schools in rural areas. According to the Communications Industry Researchers (CIR) report, the broadband satellites provide a promising alternative to conventional LAN based network solutions. To facilitate students and teachers access to the Internet at low cost, thus enabling them to receive a variety of instructional materials, such as images, audio, animation, and video efficiently, the hybrid system of broadband satellite and the Internet may provide one solution especially for schools in the rural area.

2. Project Goals and Objectives

The goals of the this project were: to assimilate, deploy, and evaluate a hybrid Internet and Direct Broadcast Satellite (DBS) system linking digital content with targeted K-12 schools in the region with advanced digital telecommunications, computing, and information technologies for the purpose of creating and delivering enhanced interactive broadband learning media; to create networkable interactive digital multimedia learning materials to be deployed through a regional digital library; and to foster innovation and experimentation in the design, development,

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and deployment of digital learning materials utilizing delivery systems capable of accommodating different learning styles based on either learner-controlled and/or teacher-controlled learning environments.

2.1 Objectives

The objectives of this testbed project were to create and evaluate the following infrastructures for the creation and distribution of digital media learning resources:

(a) A single stand-alone DirecPC workstation with access to both the Internet and Direct Broadcast Satellite transmission of media resources (Test Sites: Bethlehem, Parkland, Centennial, Hispanic American Organization, WLTV Channel 39, Service Electric Cable Company, and Lehigh University),
(b) A DirecPC workstation with access to Direct Broadcast Satellite transmission of media resources for distribution on a LAN (Test Site: Schnecksville Elementary School, Parkland School District),
(c) Satellite digital video media (MPEG I) transmitted from the Direct Broadcast Satellite and redistributed to project partners.
(d) A single stand-alone DirecPC workstation with a portable receive dish that can be repositioned as the Educational Space Shuttle travels to diverse and remote locations to redistribute media resources received from the Direct Broadcast Satellite,
(e) Create curriculum-based digital media resources for archival to and distribution from a Regional Digital Distribution Center at Lehigh University.

The content delivered in these test environments were the Video feed and Internet resources created for the JASON IX: Oceans of Earth and Beyond expedition, the CNN video feed from the Hughes transponder, and digital media content, Coral Reefs, created as a result of objective (e) above.

3. Partners

Partners collaborating on this project include the Bethlehem Area School District, the Parkland School District, the Centennial School, the Diocese of Allentown, the Hispanic American Organization, the area public broadcasting station (WLVT Channel 39), Service Electric Cable Company, and the Interactive Digital Multimedia Research and Development Laboratory at Lehigh University. Major corporations participating in this project on a contractual or service basis are Hughes Technical Operations Company and Service Electric Cable Company.

The immediate beneficiaries of this project were selected middle school age children in the Parkland School District, high school students in the Bethlehem Area School District, elementary school age children at Holy Child Elementary School, the severely emotional disturbed learners attending Centennial School, and the learner constituents served by the Hispanic American Organization of the Lehigh Valley. While elementary, middle, and high school age children were the primary beneficiaries of this test project, the benefits of these technologies can be extended to any individual or group of individuals in either a formal or informal setting depending only on the nature of the content to be delivered and access to Direct Broadcast Satellite and the Internet, and in some cases access to high speed ATM fiber networks.

4. Technical Description

The computing and telecommunications industry has drawn considerable attention with the emergence of two different but complementary technologies. The Internet has captured the imagination of the educational establishment, corporate America, and the individual consumer. More recently Direct Broadcast Satellite (DBS) systems have gained some prominence by offering high-speed data transmission (DirecPC) and broadcast quality television (DirecTV) to corporate America and into the home. The Internet has been characterized by a narrow bandwidth technology in most cases inadequate for serious interactive multimedia interchanges; impregnated with html formatted content; governed by a set of standard protocols (TCP/IP and HTTP); and generally perceived to have limitations of speed and service to remote areas by conventional means. Direct Broadcast Satellite on the other hand offers Internet access at speeds exceeding ISDN connections by a factor of 3 and at considerably less cost.

Direct Broadcast Satellite technology can deliver video on demand and high-speed connection to the Internet today. Five services/bandwidths to transmit information based on the users' needs are provided: (1) Turbo Internet Service—based on TCP/IP protocol. Users can get 400kbps average bandwidth from the total 24 Mbps bandwidth. (2) Multimedia Service—provides 1.5 Mbps bandwidth for MPEG-1 or AVI video broadcast or real-time media streams. (3) Package Delivery Service—deliver file packages to users at 3Mbps speed. (4) File Broadcast—transfer files to unlimited number of users using push technology at speed of 3Mbps. (5) Package Explorer—Users can download information package at the speed of 3Mbps [Black 1998; Montgomery 1997]. Direct broadcast to a host server and distributed via high-speed (ATM fiber) local area computer networks and Intranets have been demonstrated to be an effective means for delivering interactive learning materials to the desktop [see Figure 1].

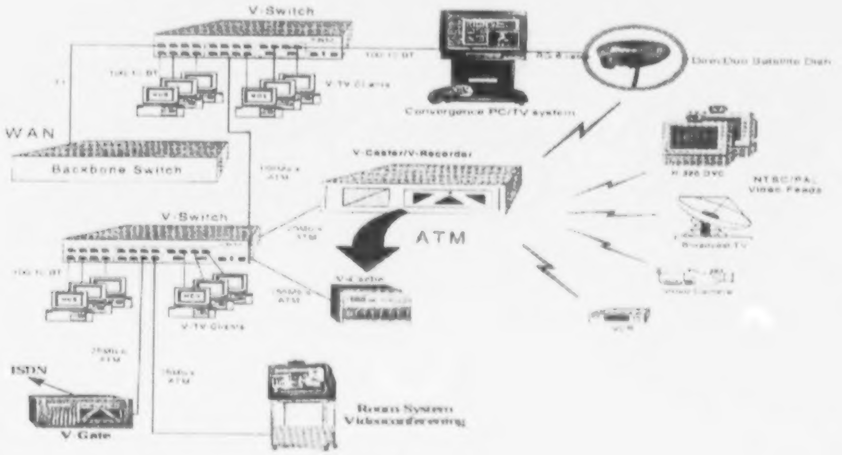

Figure 1.

Unlike the point to point connectivity model of the Internet, the digital broadcast medium has demonstrated its ability to be used in real-time or in download mode to broadcast, multicast, and pointcast a set of educational materials and content on a pre-arranged schedule or on demand. Methodologies to capitalize on the broadcast medium also include the use of cable. Broadcasting can fully complement access to the Internet or can be deployed stand-alone, that is, without a terrestrial network. Direct Broadcast Satellite and cable networks have demonstrated their capacity to enable broadcast applications and services. In addition, standard developments such as Digital Video Broadcast (DVB) and recent deployment of DBS systems such as DirecTV and DirecPC have created ready access to the technology and the services and applications of broadcasting to the classroom.

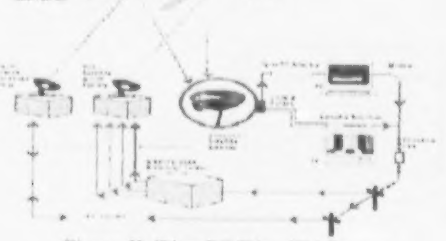

Figure II. DirecPC/DirecTV System.

Previously unrealized video on-demand, interactive television models and interactive multimedia applications have been replaced by the realities of the emergence of the massive deployment of DBS and the Internet. As a result

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access to DBS and the Internet can offer a competitive alternative or complementary adjunct to terrestrial network systems for delivery of the same services.

5. DBS/Internet/LAN Infrastructure

The DBS solutions are ideal for massive distribution of educational content organized for delivery to a single point client device or a Video Server for subsequent dissemination. The broadcast delivery mode enables the universal deployment of broadcast, multicast, and pointcast media. This therefore makes it suitable for :

- uniform content delivery to all schools and homes in a geographic region.
- targeted content delivery to a subset of very disperse schools, or
- targeted content delivery to only one target school in a remote region.

This implies that in addition to providing access to all forms of content anywhere, the same deployment over DBS can be configured to provide multilingual capabilities via audio tracks, multimedia tracks, or different text tracks. The Model exploits extensively the educational potential of standard formatted MPEG content, because of the rich set of educational content that can be packed in short clips of multisensory media and its applicability for transmission via Direct Broadcast Satellite.

6. Value as a Testbed

Direct Broadcast Satellite technologies conform to standard data transmission protocols that are compatible with most telephone, cable, and computer network systems. Consequently, the DBS technologies can be combined with any of the standard network systems to form regional hybrid network configurations compatible with a statewide telecommunications system as envisioned for the Commonwealth PEN network system. DBS technologies are both competitive and complementary to terrestrial-based delivery systems. The DBS system offers the prospect of broad bandwidth distribution of curriculum-based media resources at an affordable cost to school districts. Indeed, DBS technologies provide the enabling technologies for video on demand or on a scheduled basis from regional, national, or international databases of mediated curriculum. In addition, DBS technologies promote the development of shareable curriculum-based media resources archived in digital libraries.

7. Evaluation Results

The outcomes and benefits projected for this project were measured against the following criteria: (1) system reliability, (2) information transfer rate, (3) ability to rapidly scale and deploy systems, (4) the quality of transmitted resources, (5) compatibility with existing terrestrial networks, (6) the competitive and complementary nature of the DirecPC system; (7) user acceptability; (8) efficacy of procedures for creating curriculum-based media resources for archival to and distribution from digital libraries, and (9) adaptability to other communities. Instrumentation for assessing the project outcomes was developed to evaluate the project relative to the criteria listed above.

7.1 System reliability

The project personnel experienced problems with the initial setup of the Compaq Theatre, primarily with the 36 inch monitor (two of four had to be replaced) and problems with the TV tuner card for the Gateway System. On May 19th, 1998, the Galaxy IV satellite disappeared from its orbit and could not be contacted. Subsequently, the DirecPC dishes had to be repositioned to point to a new satellite, Galaxy III-R. The new satellite required an update in DirecPC software and the implantation of a new PCI card. The new PCI card created hardware conflicts with both the sound boards and the video cards on both the Gateway and Compaq systems. These problems were resolved by the project technician. The type of hardware and software problems encountered were not the type one would typically expect the classroom teacher to fix nor for that matter many computer technicians. One must understand however, the convergent systems were basically new technologies. It should also be noted that on the other hand, Compaq has discontinued the production of the PC Theatre and Gateway has enhanced their Destination System improving both the quality and size of their monitor with an improved computer box design having the analog and digital connections on the front panel of the computer rather than on the rear of the computer.

7.2 Information transfer rate

Multiple readings on different media applications were taken at three different times during the day: morning, noon, and early afternoon. See the matrix chart of times, file formats, encoded bandwidth rates, and download speeds [see Table I]. Use comparison charts: 56, 300, 500 kps.

DirecPC transmission speed testing results

Time	Format	bandwidth	10/14/98	10/15/98	10/19/98	10/20/98	11/02/98	11/10/98	11/11/98	Average
11:00AM	RealVideo	56k	47.9kps	46.5kps	45.8kps	46.5kps	47.7kps	45.6kps	46kps	**46.57kps**
		300k	286.8kps	277kps	283.7kps	261kps	317.7kps	292.8kps	317.8kps	**290.97kps**
		500k	227.5kps	239kps	238.9kps	223.8kps	236.7kps	238.9kps	206.5kps	**230.11kps**
	QuickTime	download	56.7kps	48k	46.8kps	43.4kps	45.3kps	46.4kps	20.1kps	**43.81kps**
		streaming	32.7kps	36.1kps	53.6kps	24.7kps	37.5kps	32.7kps	54.3kps	**38.8kps**
	Windows Media	High bandwidth	54.8kps	90.2kps	51.8kps	42.3kps	55.1kps	50.5kps	102kps	**63.81kps**
1:00PM	RealVideo	56k	45.5kps	45.8kps	45.7kps	45kps	33kps	47kps	45.6kps	**43.94kps**
		300k	295.2kps	307.6kps	312.9kps	298kps	313kps	275kps	318kps	**302.81kps**
		500k	256.4kps	155.2kps	208.7kps	239kps	228kps	237kps	208kps	**218.9kps**
	QuickTime	Download	45.4kps	54.4kps	53.6kps	31kps	30.1kps	53.7kps	33.4kps	**43.09kps**
		Streaming	32.2kps	71.2kps	45.3kps	23kps	13.8kps	31.2kps	31.2kps	**35.41kps**
	Window Media	High bandwidth	36kps	78.9kps	103kps	86.7kps	42.1kps	57.5kps	132.9kps	**76.73kps**
4:00PM	RealVideo	56k	45.8kps	44.6kps	45kps	48kps	45kps	45.7kps	41.7kps	**45.11kps**
		300k	265.5kps	214.3kps	276kps	284.2kps	217.8kps	309.6kps	318kps	**269.34kps**
		500k	236.7kps	229.6kps	239kps	236.7kps	234.4kps	238.9kps	236.9kps	**236.3kps**
	QuickTime	Download	14.2kps	40.8kps	39.5kps	48.7kps	51.2kps	46.7kps	45.1kps	**40.89kps**
		Streaming	2.3kps	10.2kps	32.2kps	69.3kps	23.4kps	20.5kps	64.7kps	**31.8kps**
	Window Media	High bandwidth	108.5kps	44.8kps	84.9kps	45.5kps	50.3kps	54.1kps	51.7kps	**62.83kps**

Table I.

7.3 Ability to rapidly scale and deploy systems

The DirecPC is a wireless technology with MPEG I and Internet distribution capability to anywhere in the United States and into parts of Canada and South America. Large scale projects utilizing the small dish technology have been or are being established in the rural communities of California and Nevada.

7.4 The quality of transmitted resources

Direct broadcast of MPEG I encoded video to client station via DBS produced VHS quality video, 30 frames/sec in screen size 320 x 240 pixels. The best quality transmission of RealVideo encoded video was done at 300 kps.

7.5 Compatibility with existing terrestrial networks

The DirecPC convergent system is compatible with and requires connection to a terrestrial Internet distribution carrier to request information to be down streamed to the DirecPC dish for individual consumption, LAN distribution, or WAN real-time terrestrial distribution systems.

7.6 The competitive and complementary nature of the DirecPC system

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The DirecPC is competitive with terrestrial ISP providers on several accounts: First the DirecPC can be quickly deployed to geographically dispersed or remote users without an expansive infrastructure. And secondly, the dollar/speed trade-off is favorable for the DirecPC distribution system. New vendors such Skystream Inc. and others are beginning to offer satellite services.

7.7 User acceptability

Users' responses to a likert type attitude scale revealed a positive predisposition toward system as well as quality of content delivered.

7.8 Efficacy of media-based Instructional Applications

The Coral Reefs application was developed for distribution on the Internet via DirecPC. The DirecPC system permits faster access to digital resources than either 28.8kps, 56kps, or ISDN distribution system. Hughes had recently joined forces with Apollo Group to provide multimedia instructional resources for schools.

7.9 Adaptability to other communities

During the past 18 months DirecPC system have been widely adopted by schools in remote areas of Canada, California, and Nevada.

8. Conclusion

Clearly, knowledge generation and learning now centralized and institutionalized will become distributed and individually paced. The combination of interactive television and the transition from a philosophy of mass communication to custom communication systems will increase both the level of user control and the complexity of design for distributed information and learning systems. It seems quite clear however, that these new systems are doomed to failure unless the learner is provided with some form of embedded help to acquire the prescribed domain knowledge. Hence the need to create new hybrid models for designing and delivering interactive mediated curricula.

The benefits of this testbed project included the identification of affordable communication structures that complement or extend extant infrastructures and add value to the educational process through the shared development and use of educational digital media resources.

9. Reference

Black, U. D. (1998). *Emerging communications technologies* (2^{nd} ed.). Englewood Cliffs, NJ. Prentice-Hall Inc.

Montgomery, J. (1997). The orbiting Internet—Fiber in the sky. *Byte*, 58, 58-72.

Riley, R. W. (July 29, 1998). *Technology and education: An investment in equity and excellence* [On-line]. Available: http://www.ed.gov/Technology/

Copyright and the World-Wide Web

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Abstract
A basic understanding of copyright law is important for all who write, perform, create, conduct research, and teach. This issue is also becoming increasingly relevant to web developers and users of web pages. Because copyright law is frequently misunderstood, one can easily violate the law and risk the consequence of being sued for copyright infringement. This essay will address the aspects of copyright law pertinent to web users.

The Purpose of Copyright Law

The purpose of copyright law is to give authors an incentive to create literary, artistic and multimedia works by granting five exclusive rights to the original production. These intellectual property rights are granted to authors of copyrighted works by virtue of the 1978 Copyright Act (Title 17 US Code). These exclusive rights are (1) the right to reproduce or copy the work, (2) the right to prepare derivative works , (3) right to distribute copies by sale, transfer of ownership, rental, or lease, (4) the right to perform the work publicly, and (5) the right to display the work publicly.

What Can Be Copyrighted

Anyone who creates a work of original authorship can claim a copyright. In fact, an author owns a copyright the moment the work is fixed to a tangible medium (paper, computer disk, video tape, cassette tape, web pages, etc.). Works eligible for copyright protection include (1) musical works, (2) dramatic works, (3) literary works, (4) choreographic and pantomime works, (5) motion pictures and audio-visual works (most web projects are audiovisual-based), (6) pictorial, graphics, and sculptural works, and (7) sound recordings.

The following categories do not qualify for copyright protection:

1. Works not fixed in tangible form (ideas in your mind)
2. Titles, names, short phrases, slogans, familiar symbols and designs, and letters
3. Ideas, methods, procedures, systems, concepts, principles, discoveries, as distinguished from descriptions, explanations, or illustrations (must be the expression of an idea)
4. Works consisting entirely of information that is common property and contains no original authorship (information that is purely factual in nature)

Notice of Copyright

Once the work is fixed to a tangible medium, the creator is afforded all rights under the law (unless the work was created for an employer as part of the creator's job duties). A copyright mark is not required unless the work is published and copies will be publicly distributed for sale. Copyright law does not require advanced permission of the copyright office in order to put the copyright notice on those works. Actually, it is the copyright owner's responsibility to apply the copyright notice to the work. The Copyright Office recommends that the notice contain three elements: (1) symbol (c), the letter C in a circle (©), the word copyright, or the abbreviation "copr.", (2) year of the first publication of the work, and (3) name of the owner of the copyright.

By giving notice of copyright (such as at the bottom of a web page) and registering the works, legal advantages become available. Notice along with registration allows the copyright owner to defend his valuable copyrights in Federal Court. The owner is also entitled to greater remedies in the form of damages and attorney fees.

Copyright Infringement

Copyright infringement occurs when a person exercises another's exclusive rights without permission. Copyright infringement requires the claimant to show (1) proof of an existing copyright (expession of idea and fixation) and (2) the exercise of another's exclusive rights without permission.

When multimedia developers scan images and download pages off the Internet, they have exercised the owner's right to reproduce the work. The right to prepare derivative works is further violated when developers use the copied work in their new creations. When these rights are exercised without permission, the second factor of the infringement analysis is satisfied. Once these factors are established, the faculty member must be able to prove that his use is justified under the doctrine of fair use. The next section explains this defense.

Fair Use - The Educator's Defense

The fair use doctrine of the Copyright Act (Title 17 US Code, Section 107) permits certain uses of the copyrighted works without the owner's consent. The statute provides that a copyright is not infringed if copies of a protected work are made for purposes of (1) Criticism, (2) Comment, (3) News writing, (4) Education, (5) Scholarship (student use), or (6) Research.

The fair use doctrine is the affirmative defense to a copyright infringement claim. It is commonly misunderstood that all academic uses fall underneath fair use. Nothing could be further from the truth. Even if the use is educational, it must pass a four-prong test set forth in the Copyright Act. Congress created this test in order to balance the interests between the author's incentive to create intellectual property and society's need to educate the public. The four factors include (1) purpose and character of use, (2) nature of the work used, (3) quality and quantity of the work used, and (4) market effect.

Purpose and Character of Use

Educational use is looked at more favorable than uses for commercial gain, but this factor is not determinative. Where new creations are the subject of scrutiny, the work's transformative nature can also play into the multimedia developer's favor. Transformation occurs when work is taken from one form (painting or drawing) and expressed in a different form (like an audiovisual work). Transformation also occurs when certain elements of a work are changed in order to change the expression of the work. An example might be where the original work's colors are changed, or where certain tangible images in the work are added or deleted.

The Nature of the Copyrighted Work

Uses of works that are factual are looked upon more favorably that works that are fictional, imaginative, or creative in nature. For example, lets suppose that I scanned an image of a "Dilbert" cartoon character off a web page that I came across and placed the image in my own web page. This factor would not help me because cartoons are considered to be very imaginative and creative in nature.

The Quality and Quantity of the Work Used

Quantity is measured by comparing the amount of the work used to the entire work. While there are no established black-letter rules to us exactly what percentage of a work can be used, it is well established that copying an entire work is usually forbidden. As a rule of thumb, most legal experts recommend that users restrict their usage of copyrighted works to less than 5% of the entire work.

Effect Upon the Potential Market for the Copyrighted Work

Many copyright authorities suggest that this is the most important factor in the fair use test. The court takes into account all possible affects of the infringement upon the owner's ability to effectively market the work. For example, let's suppose that I came across a very informative article about how copyright relates to visual art. Let's also suppose that I took most of the text from this article and placed it into my own web page or PowerPoint presentation. A court might decide that I should have paid a permission fee in order to use the work.

All four factors are considered by courts in determining whether a person's conduct falls within the scope of fair use.

FAQs About Copyright Law Applied to the Web

Use of the World-Wide-Web has raised new concerns relative to copyright law and fair use. Those issues relate to frequently asked questions (FAQs) about all types of resources available on the Web.

FAQ #1: Can I freely copy anything that is on a web page?

Making materials readily accessible to others via the Web does not mean a person has relinquished copyright. Works are considered public domain only if the author expressly puts the work in the public domain, the copyright has expired and was not renewed, the information is purely factual, or the information is a federal government document (report, statute, treaty, law, etc). Even though materials on the Web can be used freely by anyone, it is still important to consider fair use before copying anything seen on the Web. The amount of work copied will be very important in considering whether fair use applies. It is also important to remember that the nature of the work copied (factual or fictional) will also be important. When in doubt, ask permission.

Since it is sometimes difficult to discern whether or not material on a web page or even a web server is copyrighted, it is very important that ownership rights be considered. Many web pages now have the name of the WebMaster or other person to be contacted for questions regarding the content on the page and its subsequent use. Even if a person has permission to copy something from a web page, the entire resource may not be usable if the web page incorporates the work of multiple authors. Unless the person granting permission actually owns all right to the work, the person copying the web page could be held liable for infringement.

FAQ #2: Can I freely link to web sites?

Linking to other web sites raises several questions about copyright. It can be argued that a URL is not copyrightable because of its functional character for locating a web page. However, this type of link established for a web site is still a concern. Because of issues related to copying and displaying an image, it is recommended that an IMG link not be made to a web site without permission. Of course, practical concerns like the image being deleted or changed without your knowledge could also lead to problems for others utilizing your web page.

Most links used on web pages are known as HREF links because they reference other screens and cause them to appear when activated. This practice is acceptable because it promotes easy access to related groups of material and information. One exception to HREF links has evolved with the recent development of frames for web pages. The controversy centers upon others surrounding the content of a frame with advertising or editorial content, which can be misleading or confusing to the viewer relative to the original intent of the content.

FAQ #3: Can I freely download or print a resource posted on the Web?

Although information on the Web is easily accessible, one must assume that this information is protected by copyright unless it is known that the copyright owner has granted express permission to copy the work, the information is a factual government document, or the copyright has expired. Fair use limitations for materials found on the Web are essentially the same as the fair use of materials disseminated by any other means. Single copies of short items for a person's own study may fall within fair use. It has been argued that if the work is freely available on the Web, making copies will have little to no effect on the market because no commercial market for the work has been established or claimed.

However, some publishers argue that the potential market for charging Internet users for each copy means that any copying hinders the market. This is an issue of intense debate. Whenever in doubt as to whether the use qualifies for fair use protection, ask permission from the Webmaster or copyright owner.

FAQ #4: Can I freely scan images and text and use them on my web page?

The short answer is no, especially since it also depends upon the amount of materials being scanned and their intended use. While it is easy to scan images or text out of magazines, books, or other sources and place computer readable copies on one's web page, the fact that it is technically easy does not make it legal. Utilizing fair use is very problematic when it comes to images. It is arguable that fair use supports the use of images that make up a small part of the web page from which the image is taken. However, it is also arguable that the image itself constitutes a single copyrighted work, especially where the image is highly creative. The safest course of action is to obtain permission from the copyright owner before using any image found on the Internet.

FAQ #5: Can I use the Web to provide easier access to electronic documents?

Access restrictions has the greatest influence on tipping the factors in favor of fair use. A problem with making text available on any network is that it can be accessible by readers far beyond the intended audience. Restrictions on access through passwords or other systems can enable the instructor to argue that the purpose is solely to benefit the students and not to provide access for others. Restrictions can also limit the potential adverse effect on the market for the original. By limiting the range of users who may find the document, the instructor can minimize or eliminate any possibility that someone will retrieve the work from the network instead of purchasing a copy. Some critics of electronic reserves have argued that the educational purpose and the minimal market effects cannot be controlled because the electronic medium allows users to print, download, and transmit copies at little cost or effort and thereby undermine the restricted access. The instructor must closely monitor the nature of the material posted on reserves and the amount of material from the original source put on reserves.

FAQ #6: Can I freely post other people's e-mail on my web page?

No. To have a copy of the e-mail is not the same thing as to own the copyright. In fact, almost all e-mail, as written, is copyrighted. To qualify for copyright protection, a work must be an original expression of an idea fixed to a tangible form of expression. Most e-mail would meet this requirement. However, e-mail is not always confidential. One can usually report on what is sent by e-mail by spoken word. Also, one who sues over an ordinary message might not get damages because the message has no commercial value. However, to stay strictly within the law, get permission before using another person's e-mail message.

Summary

Issues related to copyright and fair use relative to the Web are still being discussed because of their complexity. While there is clearly implied permission to view web pages and to utilize web links, such an implied license does not authorize the public to do whatever is desired with material found on the Web. This approach is intended to protect the user as well as the developer, but the matter is far from resolved.

Each case concerning possible infringement of copyright brings a unique perspective to consider when judging an appropriate course of action. Clearly, one common sense way to solve the problem of potential liability is to obtain permission from the copyright owner. The legal system also permits some kinds of uses of copyrighted materials as long as it fits within the scope of the fair use test. The best solution would seem to be the creation and development of all of your own materials so that you own the copyright. Although the last option is not realistic for everyone, it is something to consider for the future as the copyright and fair use debate continues.

References

Case Law:

Wihtol v. Crow, 309 F.2d 777, (8th Cir. 1962).

Oxford University Press v. The Visitors of Longwood College, No.81-0337-R(E.Dist. Va. 1981).

Marcus v. Rowley, 695 F.2d 1171, (9th Cir. 1983).

American Geophysical Union v. Texaco, 447 F.Supp. 1156, (S.Dist. N.Y. 1992).

Federal Statutes:

Title 17 U.S. Code, Section 101 (Definitions)

Title 17 U.S. Code, Section 102,102a (Qualified Works)

Title 17 U.S. Code, Section 106,106a (Exclusive Rights)

Title 17 U.S. Code, Sections 107 (Fair Use Test)

Title 17 U.S. Code, Section 201

Title 17 U.S. Code, Sections 500-506 (Infringement and Remedies)

Law Review Articles and Periodicals:

McDonald, D., Reich, J., & Scott, E. (1996). Intellectual property and the Internet. *Computer Lawyer*, Dec., 8-15.

Barry, M. (1994). Multiple photocopying by educators and the fair use doctrine: The court's role in reducing transaction costs. *University of Illinois Law Review*, 387-415.

Merickel, M. (1989). The educator's right to fair use of copyrighted works. *West's Educational Law Reporter*, Vol. 51, 711-724.

Sewartz, M., & Hogan, J. (1984). Copyright law and the academic community: Issues affecting teachers, researchers, students, and librarians. University of California-Davis Law Review, Vol. 17, 1147-1178.

Constitutional Law:

U.S. Constitution, Article I, Section 8, Clause 8.

Internet Sources:

Brinson, J., & Radcliffe, M. An Intellectual Property Law Primer for Multimedia and Web Developers, http://www.eff.org/pub/CAF/law/multimedia-handbook

California State University, Fair Use of Copyrighted Works: A Crucial Element in Educating America. (See Illustrative Scenarios), http://www.cetus.org/fairindex.html

Tad Crawford, Internet Law FAQ, http://www.arts-online.com/writing/WO000001/miladmin/icl_faq.htm

California State University, Copyright Basics,http://www.umsl.edu/services/summer/copyrite/circ01.htm

Benedict O'Malley, The Copyright Website, http://www.benedict.com/home.htm

Oppedahl & Larson, Web Law FAQ, http://www.patents.com/weblaw.sht

Brad Templeton, 10 Big Myths About Copyright Explained,http://www.clari.net/brad/copymths.html

Preferences of Asynchronous Adult Distance Learners

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Abstract: The boom in distance education provides a unique opportunity to serve the growing adult education market, but current asynchronous distance education technologies constrain the teaching-learning exchange. A model of factors influencing the teaching-learning exchange is discussed. Several techniques have been proposed to overcome the limitations of distance education. An overview of some of these techniques is also offered. Finally, measurement of asynchronous adult student preferences regarding these techniques is presented.

Introduction

The imperative for learning organizations and life-long learning in individuals has been recognized for the better part of the last decade [Senge 1990]. Perhaps this is one reason why adult education is the fastest growing segment of the education market [Department of Education 1994]. The merger of collaborative learning and computer mediated communication (CMC) technologies is critical to ensure future educational success [Ben-Jacob and Levin 1998]. Asynchronous learning is the most flexible form of distributed education; that makes it well suited to adult learners [Black 1998]. However, the trappings of distance education have negative effects on both the education environment and the educational community [Hsu and Sammons 1998].

Learning Factors

There are five factors that have primary influence on the teaching-learning exchange [Heimlich and Norland 1994]. These include the teacher, the student, the content, the environment and the learning community. The teacher has primary responsibility for directing the exchange. Individual students are the primary targets of the exchange. The content is the knowledge to be exchanged or expected learning outcomes. The environment includes the physical surroundings and teaching artifacts. The learning community is formed by characteristics and social patterns shared by the students and with the instructor.

Studies have shown that distance education forces teachers to become better prepared, better organized, and therefore more effective [Souder 1993]. The more time that is spent up front, the more confident the teacher will be and, ultimately, the more successful the exchange [Bergmann and Raleigh 1996]. Distance education students tend to be older, more motivated, more self-disciplined, are more likely to possess a college degree, have expectations for higher grades, and, therefore, appear to be more successful than their on-campus counterparts [Champagne 1998]. In asynchronous distance learning, students take more responsibility for their own learning, reflect more deeply on the course content, and benefit from being able to tackle ideas at their own pace [Black 1998]. Learning outcomes are typically similar for traditional and distance versions of the same course, though technological issues can have an impact on the artifacts associated with content delivery [Hsu and Sammons 1998]. The technology associated with distance learning can have both positive and negative impacts on the learning environment. The availability of instructional technology may provide new tools and opportunities for concept visualization [Porter 1997], but learning exchange participants may not be comfortable with issues such as speaking into a microphone, appearing on camera, using an electronic pen or utilizing an electronic group discussion forum [Hsu and Sammons 1998]. Technology has a significant impact on the learning community

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[Brown and Duguid 1993]. Both teachers and students depend on non-verbal cues to ascertain, for instance, the level of student attention or whether the instructor would welcome a question. A bound set of the instructor's notes conveys more accuracy and authority than the same set of notes downloaded from a web site [ibid.]. Several techniques and tools have been proposed to overcome the impact of distance education on the learning community. Experiences applying some of these techniques in a graduate course for the management of research and development (EMEN5300) follow.

EMEN5300 is delivered in three modalities: a small number of on-campus students participate live in the studio classroom, a small number of regional students experience synchronous delivery via one-way video, two-way audio Instructional Television Fixed Service (ITFS), while the majority of students participate asynchronously via VHS videotape. The total enrollment was 20 students. The course production values most closely resemble the "you get what you see" (YGWYS) model [Cyrs and Conway 1997]. Students admitted to the program are required to have obtained a minimum of a bachelor's degree in an engineering or physical science discipline, so a higher than average student facility with computers can be assumed. Approximately 10% of the enrollment is believed to include non-native English speakers.

Techniques and Technologies

Course web pages can help synchronize delivery of some material to asynchronous remote students. A good course web page should include information about the course, information about the instructor, methods to facilitate course communications, assignments, text book information, distributed materials and links to related materials [Ackermann 1996]. The EMEN5300 course web page at http://www.colorado.edu/EngMgmtProg/courses/EMEN5300/ includes these all of elements and more. Approximately 10 minutes were taken during the first course session to describe the course web site for the students.

Listserv is a common tool for CMC on the Internet [Kroll 1994]. Listserv also appears to be a CMC tool of choice at the University of Colorado. Unfortunately, listserv has several limitations, or at least unattractive trade-offs, for asynchronous learners. For international students, there is often a several week delay before they receive the first installment of course materials, including information about the course web site and the listserv. If the list is set up to reflect individual e-mail messages, then remote students tend to miss many of the early posts. If the list is setup to produce digests after a lengthy delay, then on-campus and regional students lose the sense of continuity between lecture delivery and subsequent discussion. In either individual message or digest mode, the asynchronous nature of student access to the course materials virtually assures that the sequence of message topics will be jumbled. HyperNews, a web-based, threaded discussion forum, was used in EMEN5300 in an attempt to address these shortcomings. HyperNews has the benefit of leaving all messages visible without cluttering the students' mailboxes. The hierarchical structure also allows students to view messages in context. Approximately 20 minutes were taken during the first course session to introduce HyperNews.

In a traditional classroom, the students provide dynamic feedback to the teacher through verbal and nonverbal cues [Hsu and Sammons 1998]. For many distance education situations, the feedback system is more like an autopsy where the instructor tries, after the course is over, to determine why assessment scores were lower than expected [Champagne 1998]. Frequent student surveys can help overcome the lack of immediate cues, but they must be convenient to encourage students' use and relatively inexpensive to encourage teachers and the administration [ibid.]. Web-based feedback forms were developed for each course session and linked to the course home page. As the semester progressed, some problems became apparent using specific browsers with the Common Gateway Interface (CGI) program developed for dynamic feedback. As a result, roughly one-third of the students were unable to use the dynamic feedback surveys. Approximately 5 minutes were taken during the first class session to illustrate the use of the dynamic feedback forms.

The instructor should help the students visualize course materials and should reinforce materials through analogy and metaphor [Gagne 1977 as cited in Markowitz 1990]. Clip art, "word pictures" [Cyrs and Conway 1997] and PowerPoint animations were used in EMEN5300 to help create visual analogies for course concepts.

Instructors must motivate students to attend to the course materials as they are being delivered. Students who receive handouts can focus more attention on the lecture and tend to do better on tests than those that do not receive handouts [Howe and Godfrey 1977]. However, students that receive a complete transcript or set of instructor's notes can become too passive and attention suffers [Kiwera 1987]. Instructors can strike a balance by providing lecture outlines instead of complete transcripts and by leaving key words blank for the student to fill in [ibid.]. "Interactive" lecture outlines with key word fill-ins were utilized in EMEN5300. Approximately 5 minutes were taken during the first course session to describe the interactive lecture outlines.

Preferences

For most of the techniques in the preceding discussion, students had three opportunities to express their preferences. An online survey was provided after the first course session that provided either nominal or interval response scales. This survey was part of the first dynamic feedback opportunity, so the CGI problem mentioned previously was in force. A mailed survey also featuring nominal and interval scales was administered when the course was about two-thirds complete. After course completion, students had the opportunity to evaluate the course, including the techniques previously discussed, via the university's Faculty Course Questionnaire (FCQ). The FCQ utilizes 5 point Likert response scales from zero (very poor) to 4 (very good). The FCQ also invites open-ended remarks under four headings: most effective aspects, least effective aspects, best ways to improve, and other comments. Participation in all three of the surveys was voluntary and responses were anonymous. Response rates were much higher for the FCQ than for the other two forms of survey; possibly because the FCQ is familiar to the students and is administered by the university instead of the instructor.

The university's information technology service group (ITS) made an unfortunate decision to upgrade the campus web server in the middle of the semester. Students experienced problems accessing the course web site for approximately 1 week and problems accessing HyperNews for approximately 2 weeks. It is believed that this introduced some negative bias towards web-enhanced instruction into the student preference responses.

Web Site

In the initial online survey, students were given the opportunity to rate the course web site as being "Clear & Useful", "Confusing & Useful" or "Useless". Eight students responded to the voluntary survey; 88% characterized the course web site as "Clear & Useful" and one indicated the site was "Confusing & Useful". The respondent that indicated that the site was confusing made the open-ended remark, "In the beginning, the web system structure is confusing but it is just matter of time and hands-on experience." The other open-ended remark related to the course web site on the initial survey was, "I find it beneficial to read/look over the view graphs prior to class. They also help me focus on the key points of the references." This was probably a reference to the fact that the other instructors' hardcopy slides are distributed with the videotapes, but the online slides helped this particular student with the reading assignments which are to be completed before the associated lecture. This unexpected, but beneficial result reinforces the notion that the goal of handouts is to focus students on the key lesson points [Cyrs and Conway 1997]

In the mailed survey, students could characterize the course web site as "More Convenient", "Equally Convenient" or "Less Convenient" than traditional distribution methods. Nine students responded with 67% opting for "More Convenient" and 22% choosing "Equally Convenient". Two respondents made open-ended remarks suggesting the addition of a key word search capability for the course web site.

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In the FCQ, students were asked to rate the feature of downloading course materials from the web site. Seventeen students responded yielding an average score of 3.8 out of 4. One of the responses characterized the course web site as "Neutral" and none characterized this feature as either "Poor" or "Very Poor". The remainder classified the course web site as either "Good" or "Very Good". There were four open-ended comments which all indicated that the course web site was one of the most effective aspects of the course.

Taken together, these results seem to indicate a consistent, strong preference for the "Ackermann-style" web site. Since links to all of the remaining tools and techniques described herein were provided on the course web site, there may be some confounding of responses between this category and the others.

Threaded Discussion Forum (HyperNews)

In the initial survey, students were asked to rate HyperNews as being "Clear & Useful", "Confusing & Useful" or "Useless". Eight students responded; seven deemed HyperNews to be "Clear & Useful" and one indicated that it was "Confusing & Useful". There were no open-ended remarks about HyperNews from the initial survey.

In the mailed survey, students had the opportunity to indicate whether HyperNews "Improves Interaction", has "No Impact on Interaction" or "Degrades Interaction". Nine students responded to the question with 78% indicating that HyperNews "Improves Interaction". The remaining responses indicated that HyperNews had "No Impact on Interaction". The only open-ended remark about HyperNews was that the student wanted to "roll up HyperNews by discussion topic group". It is not clear what capability the student sought, but they may have been able to achieve the desired result using some combination of the HyperNews "Inline Depth" and "Outline Depth" features. In the future, more time will be spent discussing these features during the HyperNews training.

On the FCQ, the average rating for HyperNews was 3.2 out of 4. Two students out of 17 responding rated HyperNews as "Neutral" and one student rated it as "Very Poor" while the remaining responses were either "Good" or "Very Good". There were three open-ended comments about HyperNews from the FCQ that would be considered favorable. Two remarks indicated too much of a lag between assignment of the discussion question and full participation. These remarks reflect the broad geographic distribution of the videotapes and the instructor's reluctance to have strict deadlines on weekly discussion questions. While some students clearly needed this flexibility to accommodate work-related travel and family issues, other students clearly abused the system. Imposition of some sort of graduated discussion deadlines will be adopted in future course offerings.

Acceptance for HyperNews averaged approximately 80%, though the lowest rates were recorded with the second survey. This might be attributable to sampling variation. This "dip" may also have been caused by the extended down time experienced during the mid-semester server upgrade.

Dynamic Feedback

In the initial survey, students were asked to characterize dynamic feedback as having the potential to "Improve the Course", have "No Impact on the Course", or "Degrade the Course". All eight respondents indicated that dynamic feedback would improve the course. There were no open-ended responses related to dynamic feedback reported from the initial survey.

Students were offered the same range of responses with regard to dynamic feedback in the mailed survey. Six of 9 respondents indicated that dynamic feedback had improved the course and the remaining responses indicated that dynamic feedback had no impact on the course. The students offered no open-ended remarks regarding dynamic feedback with the mailed survey.

For the FCQ, the average rating for dynamic feedback was 2.8 out of 4. Nine of 15 responses rated dynamic feedback as either "Good" or "Very Good", 5 responses indicated that dynamic feedback had no impact and one respondent characterized dynamic feedback as "Poor". The students offered no open-ended remarks.

There was a downward trend in student opinions regarding the effectiveness of dynamic feedback. This may reflect that fact that the dynamic feedback CGI was incompatible with the browsers utilized by some of the students. It may also reflect a difference in students' perception of the its potential early in the course versus the perceived level of execution or follow-up as the course progressed. One factor that is thought to have impacted the effectiveness of the follow-up is related to dynamic survey design. The instructor made an effort to incorporate all of the synamic feedback provided, but the anonymous nature it difficult to "close the loop" with the student who provided the feedback and assure them that their feedback had been acted upon. There is a fundamental trade-off between anonymous surveys that encourage complete response candor and attributed surveys that give the instructor the most information and flexibility to address any issues that are raised.

Another factor appears to have been the lag in videotape delivery. In the case of international students, tape delivery lags were typically in excess of two weeks. There would be additional delays before the student actually viewed the tape, before the student completed the online survey, and before the next class broadcast. It is difficult to have the entire class "backtrack" after such a significant delay to clarify a point that may be confusing a single student. Once again, the anonymous nature of the survey precludes the instructor from pursuing one-on-one remediation. More research seems justified to characterize this trade-off between anonymous and attributed feedback.

Visualization

This technique was not explored in the initial online survey. In the mailed survey, students were asked to indicate whether clip art, word pictures and animation "Improved Understanding", had "No Impact on Understanding", or were "Distracting". Seven out of 8 responses indicated that the visualization aids "Improved Understanding" while the remaining respondent indicated that this technique had "No Impact on Understanding". The only relevant open-ended response indicated that the student liked the use of visualization techniques, but the thoughtful respondent was concerned about the amount of effort that visualization imposed on the instructor!

For the FCQ, the average rating for visualization was 3.5 out of 4. Two out of 17 responses were "Neutral" toward the technique with the remainder characterizing it as either "Good" or "Very Good". No open-ended responses were offered on the FCQ with respect to visualization techniques.

Strong, consistent support for visualization techniques is clearly indicated.

Interactive Lecture Outlines

For the initial survey, students were asked whether the requirement to fill in blanks on the handouts would "Aid Focus" or "Distract". Five responses indicated that the blanks would "Aid Focus" while one suggested that they would "Distract". There were no open-ended remarks regarding the blanks from the initial survey.

In the mailed survey, response alternatives ranged from "Increase Attention" to "No Impact on Attention" to "Distract". There were three responses in each category. There were no open-ended remarks about the handout blanks among the mailed survey responses.

With the FCQ, the average rating of blanks on the handouts for sixteen respondents was 3.0 out of 4. One respondent each characterized the blanks as "Poor" and "Very Poor" with the remainder rating them either "Good" or "Very Good". One student mentioned handout blanks as among the least effective aspects of the course in the open-ended FCQ remarks. Another indicated that the use of blanks was not befitting a graduate course. Under the "most effect aspects" heading, one student indicated all of the techniques mentioned in the preceding sections except for the handout blanks.

Average survey responses indicate that handout blanks are preferred by the students. However, the variations between survey results and within each survey are a source of concern. The option of either complete or "interactive" handouts is being considered for future course offerings.

Conclusions

Three of the five techniques investigated (web site, threaded discussion forum, and visualization) appear to be strongly preferred for students similar to those enrolled in our program. Dynamic feedback also appears to be an effective technique, but further research regarding anonymous versus attributed surveys may lead to further improvement. Blanks included with handouts should be applied cautiously; the survey results cited here indicate a great deal of variation in the acceptance of this technique. Further investigation of the factors that influence student acceptance of this technique is also recommended.

Finally, the importance of adequate support for this sort of activity cannot be overstated. The conclusions from this investigation could be much stronger if an unplanned web server upgrade (unplanned, at least, from the instructor's perspective) had not occurred mid-semester and if the commitment to a timely repair of HyperNews had been greater. Timely support to make the dynamic feedback CGI compatible with all of the students' browsers would have increased the sample size and enhanced the validity of the results reported.

References

Ackermann, E. C. (1996), Tools for Teaching: The World Wide Web and a Web Browser. *Faculty Academy '96: 1^{st} Regional Conference on Education and Technology*, Mary Washington College, Fredericksburg, VA.

Ben-Jacob, M. G. & Levin, D. S. (1998), Collaborative Learning: A Critical Success Factor in Distance Learning. *Proceedings from the 14^{th} Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 57-60.

Bergman, M. & Raleigh, D. (1996), The Accordion Curriculum: Training Instructors for Distance Education in a Higher Education Environment. *Proceedings from the 12^{th} Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 13-18.

Black, D. (1998), The Role of Live, Online Collaboration in Distance Learning. *Proceedings from the 14^{th} Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 73-77.

Brown, J. S. & Duguid, P. (1994), Borderline Issues: Social and Material Aspects of Design. *Human-Computer Interaction*, 9 (1), 3-36.

Champagne, M. V. (1998), Dynamic Evaluation of Distance Education Courses. *Proceedings from the 14^{th} Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 89-96.

Cyrs, T. E. & Conway, E. D. (1997), *Teaching at a Distance with the Merging Technologies: An Instructional Systems Approach*, Las Cruces, NM: New Mexico State University.

Department of Education (1994), *Progress of Education in the United States of America - 1990 through 1994*, Washington, DC: Department of Education.

Gagne, R. M. (1977), *The Conditions of Learning*, New York: Holt, Rinehart & Winston. Did you want to underline the title or just THE?

Heimlich, J.E. & Norland, E. (1994), *Developing Teaching Style in Adult Education*, San Francisco: Jossey-Gass Publishers.

Howe, M. J. A. & Godfrey, J. (1977), *Student Notetaking as an Aid to Learning*, Exeter, England: Exeter University Teaching Services Department.

Hsu, S. & Sammons, M. (1998), The Invisible Barriers in Teaching at a Distance. *Proceedings from the 14^{th} Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 179-185.

Kiwera, K. A. (1987), Notetaking and Review: The Research and its Implications. *Instructional Science*, 16, 233-249.

Kroll, E. (1994), *The Whole Internet*, Sebastopol, CA: O'Reilly & Associates.

Markowitz, H., Jr. (1990), *Distance Education: Staff Handbook*, Urbana-Champaign, IL: University of Illinois.

Porter, L. R. (1997), *Creating the Virtual Classroom: Distance Learning with the Internet*, New York: Wiley.

Senge, P. M. (1990), *The Fifth Discipline: The Art and Practice of the Learning Organization*, New York: Doubleday.

Souder, W. E. (1993), The Effectiveness of Traditional vs. Satellite Delivery in Three Management of Technology Master's Degree Programs. *The American Journal of Distance Education*, 7, 37-53.

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Assessment of Alternate Delivery Mechanisms for Asynchronous Adult Distance Learners

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Abstract: Unrelenting progress in computer and telecommunications technology is creating new opportunities and new challenges in distance education. These technologies have the potential to free students and instructors from the bonds of time and space. However, the adoption of new technologies should not exclude prospective students. The development and evaluation of an online alternative to videotaped lectures is presented. Videotape usage factors, feedback regarding online alternatives, and barriers to adoption of online lectures are explored.

Introduction

Colleges and universities are rushing to implement distance education [Sherron and Boettcher 1997], but are our students ready? Utilizing technology is still problematic for some students [Ingebritsen and Flickinger 1998], so new delivery methods should be as easy to use as the technologies that they replace. Less than 23 percent of households had computer systems in 1993; if the growth trends at the time hold, approximately 30% of households will have computers by the turn of the century [U. S. Census Bureau 1993]. This suggests that adoption of emerging distance education technologies brings with it the risk of excluding large numbers of potential students.

The vast majority of Engineering Management students at the University of Colorado participate asynchronously via VHS videotapes provided by the Center for Advanced Training in Engineering and Computer Science (CATECS). Students return the videotapes at the end of the semester. Courses have low production values, referred to by the CATECS Program Director as "candid classroom". Students admitted to the program are required to have obtained a minimum of a bachelor's degree in an engineering or physical science discipline, so a higher than average student facility with computers and a higher than average rate of computer penetration into student households can be assumed.

Digital Lecture Design

Within a course addressing the management of research and development (EMEN5300), a comparison of alternate asynchronous delivery media was conducted. For the course session on the management of intellectual property (Session 12), asynchronous students were given access to the VHS tapes traditionally utilized with EMEN5300, plus web-based and CD-based (digital) lecture alternatives. The objectives of the comparison were (1) to determine student preferences, (2) to ascertain the penetration of the computer technology necessary to utilize the alternative digital delivery methods, and (3) understand the usage patterns for the current video tapes to improve the design of future delivery systems.

Steps were taken in the delivery media comparison to exert experimental controls over the five factors that influence the teaching-learning exchange [Heimlich and Norland 1994]. Each of the delivery alternatives featured the same instructor and was delivered to the same student population. The session slides, discussion forum and course artifacts were also identical for each of the delivery methods. The session was pre-recorded on VHS and the audio was extracted for use with the digital media, so the lecture audio content was identical for each delivery vehicle. However, video content posed some interesting trade-offs.

Exclusion of the video from the digital media might cause the students feel as though they were "missing something" and bias them against the digital alternatives. However, inclusion of the video greatly increased the size of the digital files, requiring multiple CD volumes for a two-and-a-half hour lecture, and perhaps slowing content delivery to unacceptable levels. A review of the course video revealed that over 50% of the video content consisted of images of the session slides. These slides were to be available in another multimedia window in the digital delivery environments. Also, with all of the currently available streaming media encoding technology, the resolution of these slide video images would render them illegible. The prospect of over 50% of the video content being both redundant and illegible also presented the possibility of student bias against the digital delivery alternatives. The remaining video content consisted primarily of "talking head" shots of the instructor. One of the most fundamental conflicts in distance learning is whether the content should be adjusted to take advantage of the new medium or reproduced as faithfully as possible given the constraints imposed by the new technology [Ben-Jacob 1998]. Taking all of these factors into consideration, a decision was reached to exclude the video content from the digital delivery alternatives and include a question about the value of the video content in the student preference survey.

Simple navigation was a key design goal for the online lesson. Unlike books and videotapes, there are no widely accepted principles for organizing and navigating the multi-dimensional electronic information space [Bevirt 1996]. Principles for organization and navigation were sought that would be applicable across course sessions and across courses. An effort was made to develop an interface that could be deployed via either the web or CD with a minimum of modification. Unix shell scripts were developed to automate the most redundant and time-consuming tasks. Audio for the CDs consisted of full resolution *.wav* files. Audio for the web was encoded using *VivoActive* because it permits audio streaming via the Hypertext Transfer Protocol (HTTP) so no special web server software or configuration was required.

The starting point for session navigation is the lesson home page. The lesson home page includes the course number and the session number within the course. The page also includes hyperlinks to the outline for the lesson, the table of contents for the lesson slides, a link to the first slide of the lesson and links to contact the instructor. The cover page also includes hyperlinks to download any viewers or plug-ins required for the handouts and the lesson.

Each lesson is decomposed into slides. Slides are generally intended to be viewed sequentially, but the table of contents for each lesson facilitates non-linear traversal of the slides. Each slide includes four areas: the slide image in the lower left corner, an icon returning the user to the lesson home page in the upper right corner, a horizontal navigation bar in the upper left corner, and a vertical tool bar in the lower right corner. The slide image presents the unique material to be covered at this point in the lesson, while the home page icon, navigation bar and tool bar are intended to be consistent across slides, across lessons, and across courses. The navigation bar and tool bar are orthogonal [MacLennan 1983] in the sense that the navigation bar represents movement within the current lesson and the tool bar represents resources outside of the current lesson. The Hypertext Markup Language (HTML) "ALT" and "ONMOUSEOVER" tags are utilized throughout the lesson, so that the buttons are self-documenting.

The navigation bar represents an ordinal scale [Agresti 1990]. The left-hand icon takes the student to an absolute location, the first slide in the lesson. Moving to the right, the second icon takes the student to a relative location, the slide immediately preceding the current one. The middle icon on the navigation bar provides the "origin" for the ordinal scale; it takes the student to another dimension composed of additional multimedia resources that elaborate on the current slide. In most cases, the middle icon takes the student to the relevant audio clip. The session topic was intellectual property management, so the middle icon sometimes linked to another web site with more detailed information, such as the US Patent and Trademark Office or the Library of Congress. The remaining two icons on the navigation bar are complementary to the first two icons. The fourth icon takes the student to the relative position of the slide immediately following the current one. The last icon on the navigation bar takes the student to the absolute position of the last slide in the lesson.

The top icon on the tool bar permits the student to contact the instructor via e-mail. Moving down, the second icon provides the student access to the threaded course discussion list (HyperNews). The third icon on the tool bar guides the student to the home page for the University of Colorado library system. Once there, the student can search for literature by title, author, subject and keyword. The fourth icon allows the student to search all web pages in the colorado.edu domain, including the library system. The bottom icon allows the student to search the entire Internet via the "hotbot" search engine.

Delivery Technology Assessment

Students had two opportunities to express their preferences. A mailed survey was administered immediately after Session 12. This survey featured nominal and interval response scales, plus the opportunity for open-ended response. The mailed survey was reviewed and approved by the University of Colorado Human Subjects Committee. After course completion, students had the opportunity for a less comprehensive follow-up assessment via the university's Faculty Course Questionnaire (FCQ). The FCQ utilizes 5 point Likert response scales from zero (very poor) to 4 (very good). The FCQ also invites open-ended remarks under four headings: most effective aspects, least effective aspects, best ways to improve, and other comments. Participation in both of the surveys was voluntary and responses were anonymous. Response rates were much higher for the FCQ than for the mailed survey; possibly because the FCQ is already familiar to the students and is administered by the university instead of the instructor which may, in turn, inspire more confidence that their anonymity will be protected.

With the mailed survey, students were asked for feedback in three categories: usage factors for VHS videotapes, preferences with respect to the digital delivery alternatives, and equipment barriers to utilizing the digital alternatives.

Videotape Usage Factors

All nine students responding to the mailed survey, from a total enrollment of 20, indicated that home was the primary location for videotape viewing. One student's open-ended remark indicated that they occasionally viewed videotaped lectures during business travel. Seven students indicated that they typically viewed the tapes in one sitting and rarely, if ever, rewound to review. One student indicated that they typically watched in one sitting, but rewound often. The remaining student indicated that they typically watched a single course session in multiple sittings. Two of nine students responding agreed with the idea that they reviewed the videotapes after the initial viewing to prepare for homework and/or tests, while the other seven disagreed with that notion. Three respondents indicated that they would rather be live on campus for the initial lecture delivery, while 6 stated a preference for videotape, and none favored either of the digital alternatives. For reviewing lectures, 3 students preferred videotape, 4 preferred the CD and two did not respond to the question. One of the unresponsive students made the open-ended remark that they preferred to review from the handouts, an alternative not provided on the multiple-choice question. Two students indicated that the audio and video quality of the VHS tapes was occasionally unacceptable. Four students indicated that they would value access to the lecture beyond the end of the semester, but the other five respondents did not attach any value to extended access to the lectures. It is not clear whether students currently enrolled in a course have the proper perspective to know whether they would want access to the materials at some point in the future.

Digital Lecture Preferences

The number of survey responses regarding the digital alternatives was typically smaller because some students lacked sufficient computer resources to fully utilize the web- and CD-based alternatives. Eight out of nine students found navigation in the digital lessons simple and intuitive, while one found it to be complex. Six of seven respondents said that the slides in the digital presentations had the right balance of legible size and fast loading, while one student indicated that the slides needed to be larger. Six of seven also indicated that the opportunity to embed links to other web sites was valuable, though one respondent stated that there was no additional value to the links. Five out of seven students indicated that the synchronizing aspects of web delivery had the potential to make team projects easier to accomplish.

Three out of six students found that video was not necessary with the digital alternatives, but the other half of the responses indicated that video should be included. One student indicated in the open-ended comments that the student should be given the flexibility to choose small or large slides and audio-only or audio/video presentation. It is believed that if the students had the chance to observe the digital video resolution and recognized the fact that the majority of the video content consisted of slide images, that the students would ascribe less value to having the video available in the digital format. Fifty percent of the respondents also indicated that the digital audio resolution was satisfactory, while the other half stated that higher resolution was preferred. The fact that the digital audio was captured from the original VHS recording resulted in degraded digital audio quality. Subsequent investigation indicates that direct digital audio capture results in much better audio quality without increasing the size of the audio files.

One student indicated that, as long as they had to be at the computer to view the lecture, an on online editing capability for the handouts should also be provided. Another respondent indicated that the middle button on the navigation bar should consistently play the audio instead of occasionally leading to other web sites, and that an additional button should appear on the navigation bar when, and only when, there are links to additional information. With the suggested additional button, the navigation bar would no longer represent an ordinal scale; this would make the interface potentially less intuitive. Also, having a button that doesn't appear on every page violates interface "consistency" [MacLennan 1983]. On the other hand, a button that plays an audio clip on some occasions and links to another web site on others is also a "consistency" violation [ibid.]. Additional testing focused of this interface design trade-off is indicated.

On the FCQ, 17 respondents gave the videotapes an average rating of 1.8 and 13 respondents gave digital delivery an average rating of 2.9. The average rating for navigation in the digital lessons was 3.0 for eleven students responding. There were four open-ended comments related to the digital delivery alternatives. The comment "I liked the CD lecture too; very easy to get to the needed audio portion of a particular lecture" was included as one of the most effective aspects of the course. A second respondent also indicated that the CD was one of the most effective aspects of the course. "Web presentation ok" was included in the "other comments" section. One student indicated "Sessions on CD" among the best ways to improve the course, but it isn't clear whether they are indicating a need to improve the CD method of delivery or a desire to have the whole course delivered via CD. Under least effective aspects of the course, one student indicated that they could not use the CD, but weren't sure whether the CD or their computer was the source of the problem. Two respondents indicated under "other comments" their appreciation for the instructor's creativity in utilizing new tools for distance learning, but a third student indicated that the distance education "experimentation" was a source of distraction from the course materials. There were three comments indicating quality and/or delivery problems with the VHS videotapes.

Barriers to Digital Lectures

In the mailed survey, students were asked to indicate all factors that presented barriers to utilizing digital lectures. Subsequently, some students identified more than one barrier. Out of nine respondents, there were four indications of no sound capabilities, one indication that the computer was too slow, one indication that the CD player was too slow, and one indication that the Internet connection was too slow. In the open-ended remarks, three respondents indicated that they had computers at work that were capable of utilizing the digital lectures, but that their home systems were inadequate. One student indicated plans to buy a sound card. Another indicated that they typically didn't have Internet access during occasions of business travel. One student mentioned that they had to click "OK" in several dialog boxes each time they played an audio clip from the CD. At least one of these dialog boxes is probably associated with the browser; the most popular browsers prompt the user whether they want to save the file to disk or "view" the file with the appropriate application. It is possible to configure these browsers so that they don't prompt the user each time they access a new file, so this shortcoming may well be addressed by additional training. Virus protection software may be the source of another prompt. *Norton Anti-Virus* can be configured to

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limit the file types scanned based on the filename extension, so additional training may resolve this deficiency as well. If "several" dialog boxes implied more than two, it is not readily apparent what are the sources of the other prompts; the anonymous nature of the survey precluded further investigation of the student's situation.

Conclusions

Caution is recommended with respect to a shift of course delivery media to CD or the web. Based on the survey results, approximately 50% of the students enrolled in EMEN5300 lacked convenient access to sufficient computer resources to take advantage of these alternate delivery mechanisms. Dictating the need for sufficient computer resources as a course prerequisite is one way to address this issue, but the high cost of such a requirement could jeopardize enrollment levels. However, this situation bears close monitoring since Moore's law indicates that computer capabilities double in a mere 18 months [Ziems 1996].

The concern raised by one student regarding of the issue of distance education "experimentation" is a valid one. Many studies, for example [Barker 1998] and [Ingebritsen and Flickinger 1998], compare a traditional course taught in one semester or to one group with a revised course taught to another. Although such an approach makes it less obvious to the students that they are experimental "subjects", it is still likely that time is being taken away from course content to deal with the technology. Such an approach also makes it harder to control experimental variables and validate conclusions. In either case, some sort of risk/reward analysis is justified to make sure that the benefits of the research warrant the reduction in course content that the experiment may entail. It is also recommended that, unless it violates the research protocol, students should be informed of their role in the experiment and made aware of the potential benefits for future students.

References

Agresti, A. (1990). *Categorical Data Analysis.* New York: John Wiley & Sons.

Barker, T. B. (1998). Developing Courseware for Distance Learning: Any Place, Any Time. *Proceedings from the 14th Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 33-39.

Ben-Jacob, M. G. (1998). Teaching Mathematics, Science and Technology on the Internet: A Workshop (Description) for Educators in the New Millennium. *Proceedings from the 14th Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 49-55.

Bevirt, B. (1996), Designing Hypertext Navigation Tools. *WebNet 96 - World Conference of the Web Society Proceedings*, edited by Hermann Maurer, Association for the Advancement of Computing in Education, Charlottesville, VA. 1-6.

Heimlich, J.E. & Norland, E. (1994), *Developing Teaching Style in Adult Education.* San Francisco: Jossey-Gass Publishers.

Ingebritsen, T. S. & Flickinger, K (1998), Development and Assessment of Web Courses That Use Streaming Audio and Video Technologies. *Proceedings from the 14th Annual Conference on Distance Teaching & Learning*, University of Wisconsin-Madison, Madison, WI. 195-201.

MacLennan, B. J. (1983), *Principles of Programming Languages: Design, Evaluation, and Implementation.* New York: Holt, Rinehart & Winston.

Sherron, G. T. & Boettcher, J. V. (1997), *Distance Learning: The Shift to Interactivity.* Boulder, CO: CAUSE.

U.S. Census Bureau (1993), "Computer Use in the United States: Level of Access and Use of Computers: 1984, 1989, and 1993. Table A", published October 1993, Washington D.C. <http://www.census.gov/population/socdemo/computer/comp1.txt>

Ziems, C., Keep it simple: Dull applications deliver. *InfoWorld*, 18 (50).

Computer based instruction of professional psychological skill acquisition

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Abstract: The developments in information technology and multimedia gives new opportunities to increase the efficiency and quality of skills education. Three different applications are presented that are developed to enhance the professional skills learning in different areas of Psychology. The areas that are covered consist of the instrumentation techniques in biopsychology, job and task analysis, and selection and assessment in organizations. The applications use multimedia to enliven the course and to improve students learning of skills. The innovative features of the applications are illustrated in this paper. Furthermore, some results will be presented of the evaluation of students experiences with the programs and of the learning progress as a result of working with the programs.

1. Introduction

The acquisition of analytic and counseling skills is one of the preconditions to prepare psychology students for their professional career. Education of skills not only emphasizes the understanding of theories but also involves the qualitative understanding of concepts and the training of procedural knowledge. Training of skills is often regarded as highly work intensive. However, advances in information technology and multimedia have facilitated the possibilities to support skills acquisition and to promote self-instruction and computer-based instruction. Despite these new opportunities, only few applications exist that train psychological skills thoroughly.

In 1996, a large fund of the Department of Education of the Dutch Government (Dutch: Kwaliteits- en Studeerbaarheidsprojecten) stimulated several educational innovation projects to support the continuing development of ICT-based learning material and courses. Major goal of this fund was to encourage universities and colleges to innovate and improve their courses and thereby facilitating the flow of students through a four-year educational curriculum. A project, submitted by Lang & Meijman (1996) to enhance the professional skill acquisition in psychological education was granted. This project consists of four subprojects of which three will be presented at the WebNet99 conference.

BioPsy is an application that is developed to teach and train the technical and practical backgrounds of conducting biopsychological experiments. PAMA is a digital learning environment in which students can develop professional skills to analyze, evaluate and (re)design human work. The development of skills to conduct personnel selection procedures are taught with the application Selection.

This paper briefly outlines the structure of the projects and discusses the pedagogical background, the implementation of the applications and the evaluation of the courseware. In the associated poster and demonstration sessions, the applications will be presented.

2. Theoretical considerations

All courses are in addition to, or replace parts of the regular courses. Biopsy, for example, is an "add-on" module where students can study background information and make exercises. Selection provides the student with theory and exercises previously presented on paper and videotape, where the results are subsequently discussed in working groups. PAMA replaces regular instruction for a large part, integrating theory, examples and exercises in a digital environment.

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Four general principles are present in all of the applications:

1. They are developed in a cognitive- and social-learning theoretical framework where students learn by example (modeling), practical exercises and feedback.
2. Several types of multi-media elements are presented in the applications, e.g. video- and audio-fragments, animations and illustrations.
3. Case-materials include real-life or simulated settings. This ensures transfer to real-life situations and makes the programs more attractive.
4. The programs allow students to proceed in their own pace and provides them with the possibility to choose extra exercises when wanted.

The theories of knowledge and skill acquisition underlying these principles consider learning as a result of a student actively understanding, selecting, comparing and judging information (e.g. Vygotski, 1978). This means that an active role is expected from students. The teacher's role is still important, but more a monitoring one, leaving more responsibility to the students. It is important for students to develop some metacognitive knowledge about the course subject, i.e., to develop general abilities they can apply to all problems they encounter, by learning by example. A consequence of this learning style is that an emphasis must be placed on learning in a meaningful context and that students can discuss the results with each other. All three programs provide a meaningful context by using real-life examples and cases. For example, in the program PAMA a time restriction in analysis time is included, just as in real life. Discussion between students is facilitated by working in couples and by creating the possibility for chatting or mailing.

Although all three programs are built around the same theoretical principles, some differences can be distinguished. These differences can best be described by the distinction between "whole" versus "part" learning. Partial learning is the breakdown of knowledge and skills in separate, selfcontaining elements which are presented to the student. These elements are studied, step by step, and in the end the student is instructed to combine those elements. Selection and BioPsy are examples of this approach. PAMA fits the description of whole learning better, as it provides the student with elements that are more intertwined with each other. This means that contrary to Selection and BioPsy, PAMA requires more the creation of a mental map of the subject matter and the combination and integration of the elements as they encounter them. Students are not completely left on their own to do this, as the program provides them with references to additional information and hints. Students have to search for this information themselves and it is expected that they not only learn from the information they find but also from the search-process self. In this context another distinction can be made between "explicit" and "implicit" learning. In contrast to e.g. Selection, where all relevant information is accessible in the program and is made explicit what has to be learned, PAMA focus more on implicit learning. In PAMA, the student has to create its own knowledge base and theoretical framework in addition to the information provided by the program. One of the tasks where this becomes apparent is in the construction of a personal textbook with all the documents and assignments a student has discovered and finds relevant. The assignments are constructed in such a way that the student individually discovers the necessity of a stepwise procedure and thereby improving theoretical and methodological insight.

Flexibility for the students is achieved by providing the program in a network environment. Selection and Biopsy and part of PAMA are traditional OS specific applications distributed via an Intranet, and a part of PAMA via the OS independent Internet. In addition, all programs are available on CDROM. Apart from the fact that different learning styles affect the pace of a student, practical issues are also at stake, especially in higher education: a significant amount of students have part-time jobs or are restricted in some other way to attend classes on a regular basis.

Although the possibility exists for students to use the programs individually, they will be encouraged to form teams of two. This enforces a way of collaborative learning where students exchange experiences, perspectives and discuss alternatives. The program PAMA is most advanced in this perspective, in that it provides different means of discussion like Internet newsgroups, mailinglists and chat. The student's own input is important in these fora, the teacher only monitors these discussions and stimulates them when necessary.

3. BioPsy

Students who specialize in Experimental Psychology are confronted with a substantial amount of technical information necessary to conduct biopsychological experiments in the laboratory or in field studies. Although mathematics at high school level is a precondition to enter psychological education, several students have difficulties understanding these technical aspects. BioPsy is developed to support those students who are confronted with deficiencies in knowledge of physics and electronics. It is also developed as a remedial teaching tool for those students who have become a bit unacquainted on the technical area. The application is additional to face-to-face teaching with the lecturer and can be completed at any convenient time. Multi-media elements are used to enliven the course material.

The application consists of three different modules of retrieval and acquisition of information. The first module is the search-module in which the student can search on specific terms or within specific topics. All matches of the search term are displayed and can be sequentially selected and examined by the student. Several videos, animations and images are included in the application to support the course material. Students can also exercise the principles of signal processing in a simulation environment through the manipulation of filter and sampling parameters.

In the second module, the student can follow an introductory course on biopsychological experiments. This module is presented in a classic book-structure. The complete course consists of six books:

a. Electronics
b. Biopsychological signals
c. Controlling experiments
d. Personal Computer
e. Safety and accidents
f. Processing of signals

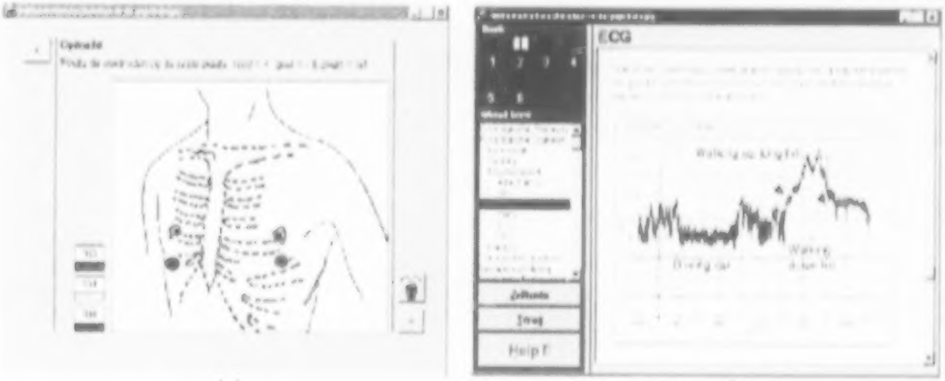
The progress of the course can be saved and retrieved. After studying a book the student can answer some multiple-choice questions to test the degree of acquired knowledge.

In the third module the student can apply the knowledge in different exercises that are related to a real experiment. Approximately twenty-five exercises are constructed for two different experiments, a classic reaction-time experiment and an experiment in which the electroencephalogram (EEG) is measured. Crucial aspects of these experiments are trained to prepare students in actual experimentation.

In the reaction-time experiment subjects have to design a memory-search task and the necessary technical and experimental prerequisites. Emphasize is placed on designing the experiment, preparing the stimulus material and programs, instructing the subjects, registering heart rate and heart rate variability and analyzing and interpreting the results.

The second experiment consists of a semantic task in which meaningful and meaningless words are presented in normal daily sentences. During this experiment the EEG is measured from which Event Related Potentials (ERP) have to be computed. Focus in this experiment is on the registration of the EEG-signals and the necessary steps to calculate ERP's. The two experiments are a good reflection of the technical problems that are encountered in biopsychological experiments.

The program BioPsy is demonstrated at the WebNet 99 conference (Poster/Demonstration of R.J. van Ouwerkerk, T.F. Meijman & L.J.M. Mulder).



(a) (b)

Figure 1: In the exercise module of BioPsy students have to place electrodes on the appropriate spots of the body (a). Illustrations are used to enliven the material in the course module (b).

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4. PAMA

The acronym PAMA is made up of the initial letters of the Dutch terms "Psychologische Analyse van Menselijke Arbeid" and can be best translated as "Psychological Analysis of Human Task Performance". The PAMA courseware provides an introduction to the theory and practice of work and organizational psychology. The course offers work and organizational psychology undergraduates a computer-based interactive exercise of the analytical skills relevant to the execution of a psychological analysis of human task performance.

PAMA consists of three modules. The first module provides an introduction to models of workload and recovery, work satisfaction, work and physical and psychological health, et cetera. It draws on recent theory and research to offer students a perspective on work and organizational psychology. The second module provides students with models, theory, and methods of psychological analysis of human task performance, and provides students with practices of professional skills. It offers students a method of analysis that should be followed to perform an adequate analysis of work activity. It also includes the available instruments and techniques for performing a psychological analysis. The third module is designed to support the development and advancement of professional skills that are required as a work psychologist. Assuming that the power of a real-life case will make learning more attractive and effective, the actual skills can be practiced in a predefined and elaborated case that focuses on the job of nurse at a department of nephrology and kidney transplant. All materials provided by the application are the sources for carrying out the job analysis.

The modules one and two are made available in a digital learning environment that can be approached via the Internet. The introduction to theory and research is included in electronic books and can be printed to form a conventional paper textbook. However, the electronic book contains additionally educational material. The book of module one in particular includes several concrete examples to illustrate the subject-matter, and also exercises and assignments, whereas modules two provides students with the opportunity to develop and practice their skills. Therefore, the second module calls attention to several psychological instruments for job and task analysis that can be explored and exercised, and several data-sets are available that provide the opportunity for students to consider the methodological and statistical aspects of job analysis. All in all, this requires the students to explore the literature on work and organizational psychology and it will prompt them to adopt an active, self-employed role in gathering additional subject-matter. Moreover, the modules allow the student to be responsible for his or her own learning to match the prior knowledge and learning style. As a consequence, each student composes his or her own unique textbook. As a side-effect, he or she will be able to visualize and increase his or her knowledge about the theory and research on work and organizational psychology and the methodology of psychological analysis of human task performance.

All the chapters with texts, the video and audio fragments and the exercises are present in a SQL-database for the Internet. A webserver translates the queries into readable html-pages, dynamic lists and multi-media elements. Teachers can dynamically add, delete and change the order of the educational material at the beginning of a course. Dependencies between chapters and exercises can be assigned to include restrictions in the accessible material. Also the correction of answers on open questions by the teacher is supported in the system. The login procedure of the student is secured by using a challenge response user authentication. The student can view all the material and can send answers on questions and exercises to the database to be reviewed by the teacher later. The student's progress of the course is tracked and administrated. This information is used in the evaluation stage of the project to determine individual learning strategies. In figure 2 the general layout of the digital learning environment is depicted.

Unlike the former modules, the third module will be available via the Intranet. Using a case-based learning application, the course provides the opportunity for students to act as a work analyst and to learn that job analysis is a complex task and involves efficient planning. In this module, students are presented with a case that requires them to perform a psychological analysis of human task performance. They are expected to apply their knowledge (acquired by examining modules one and two) to analyze the job of nurse at a department of nephrology and kidney transplant at the Academic Hospital Groningen in the Netherlands. As a result, all the basic knowledge should be integrated to facilitate execution of the psychological analysis of human task performance. This requires that students study all relevant materials in modules one and two as they pursue the case in module three. The relevance of the subject-matter in modules one and two is apparent, because students become aware of a need for accurate knowledge when proceeding with module three. This provides students with a course that reinforces what they have learned and encourage them to apply that knowledge in a virtual setting of a work and organizational psychologist.

All necessary information will be available via the Intranet and consists of reports and documents, auditory interview fragments, video-fragments, and data from questionnaires and behavioral observations, but also includes information that is irrelevant to the case. Furthermore, students will be required to carry out a complete analysis in a fixed (but fictitious) amount of "analysis time" and retrieving any information will reduce the remaining time. Thus, students need to carefully plan each step in the analysis and to consider which information is relevant. By doing so, they become aware of a need for an efficient research method, which makes the module a challenging exercise.

The job analysis involves several steps. In each step, the student is required to submit a plan. After the plan is checked by the application, the student is provided with feedback. The courseware was programmed to compare the submitted plan to a previously fixed analysis planning and to provide the student with different forms of preprogrammed feedback. So, the student is repeatedly receiving positive reinforcement regarding his or her skills as well as constructive feedback for rectifying any identified inadequacy. As soon as the plan meets certain requirements, the student can proceed and act according to the plan. After finishing each analysis step, and before proceeding, the findings should be summarized in a short written report. In conclusion, a full written report on the complete job analysis should be prepared that consists of the short reports prepared in each analysis step.

The program PAMA is demonstrated at the WebNet 99 conference (Poster/Demonstration of F.L. Oldersma, M.N. Hoebe, R.J. van Ouwerkerk, A.H.G. de Vries-Griever & T.F. Meijman).

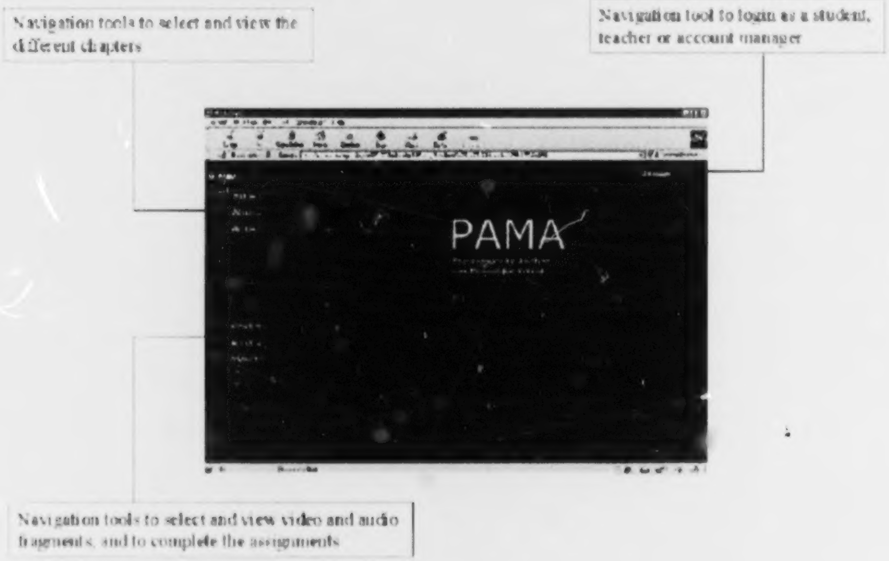
Navigation tools to select and view the different chapters
Navigation tool to login as a student, teacher or account manager
PAMA
Navigation tools to select and view video and audio fragments, and to complete the assignments

Figure 2: Introduction screen of the digital learning environment of PAMA. Several navigation tools are present to view and process information.

5. Selection

The application Selection is aimed primarily at students who are educated in the psychology of assessment and selection of other people at work. The program considers the process of selection (the activities involved) and the content of selection (the techniques, tools and methods used). The process and skills for professional consultancy are taught in a self-instruction course. The student acts as a junior adviser who has to select the most eligible secretary from a group of applicants. The entire selection procedure is stepwise completed by the student in which he or she is instructed and advised by a (virtual) senior consultant.

The selection procedure consists of nine consecutive steps. The first step of the program aims to clarify the question of the client. In the next step the content of the function is determined which is further specified in function requirements in the third step. After this step the necessary predictors are

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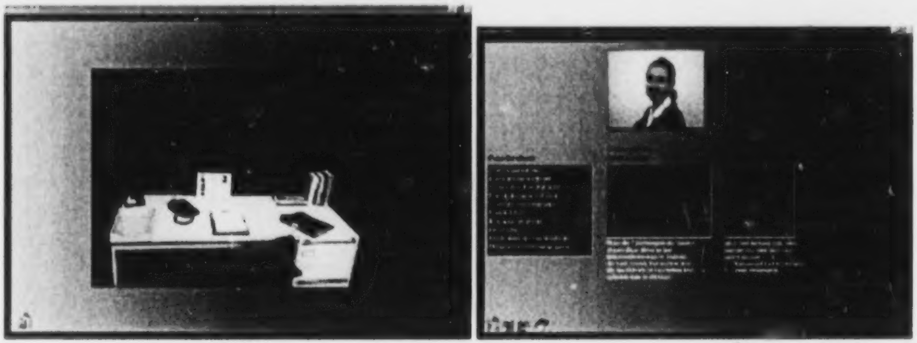
determined. The tests that contain the predictors are selected (step 4) from a pool of tests and presented to the candidates (step 5). In step six the test scores of the candidates are interpreted and weighted. On basis of these results a few selected applicants are invited for a selection interview. The final suitability of the applicants is rated and determined in step eight. In the final step a rapport is written in which a candidate is recommended to the client.

The program makes extensively use of video- and audio-fragments that can be viewed or listened to by the student. Also several psychological aptitude tests are present to guide the selection process. After each step the student is provided with feedback on the results and he or she can correct the responses.

The program Selection is demonstrated at the WebNet 99 conference (Poster/Demonstration of M.N. Hoebe, K.I. van Oudenhoven-van der Zee & R.J. van Ouwerkerk).



(a)

(b)

Figure 3: The interface of Selection (a) that is used by the student is structured as an office environment in which several input devices can be used to collect and retrieve information e.g. calendar to make appointments, a phone to consult the senior etcetera. Several screens (b) are present in which the student can view video fragments, and can select and drop relevant items.

6. Evaluation

All applications that are developed in this project are evaluated by students. The evaluation is based on the students' attitudes towards the software, their ratings of usability and their learning as a result of the applications. The first step in the evaluation is a heuristic evaluation in which the content and usability of the interface of the application is rated. In a follow-up study the attitude towards the applications and the progress or decline in learning efficiency is examined in more detail. Two groups are compared: a group of students that did not work with the application and a group that worked with the application. The differences in test scores is used to determine the effectiveness of the innovation. The amount of time spent on mastering the skills provides information on the efficiency of the application. The group of users of the application further evaluates the usability, transparency, consistency and attractiveness of the application.

7. References

Lang, G. & Meijman, T.F. (1996) *Enhancing the professional skills education in the study of Psychology.* University of Gronuingen: Internal Report

Vygotski, L. (1978) *Minds in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.

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A Generic Metadata Query Tool

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Abstract: This paper discusses a generic query tool that enables an end user to query a metadata store through filters that impose search criteria on attributes. The Metadata Query Tool (MQT) is generic in the sense that it dynamically creates its user interface, based on configuration files that define the metadata scheme and the query functionalities. Although the tool can in principle be used to query any (view on a) relational database, we have developed it to query educational metadata, stored in the ARIADNE[2] Knowledge Pool System [Forte, Wentland & Duval 1997].

1. Introduction

Metadata can be described as "data about data". A good example is a library catalog, which contains information (metadata) about publications (data). Advantages of using metadata to describe electronic resources are numerous [Iannella & Waugh 1997] and include the possibility to efficiently search for data.

Creating an intuitive and powerful Web tool for metadata querying is not an easy task, the more so if we want to develop this tool in a generic way, i.e. without 'hard coding' a particular metadata scheme into it. Moreover, we also want the tool to be flexible in the sense that the query functionality itself must be configurable: the user interface should reflect the important metadata fields and provide a user friendly, yet powerful, mechanism to query the metadata instances. The ideal user interface may depend on the (type of) user and his/her interests and therefor should not be fixed given a certain metadata scheme.

This paper describes how we have developed such a tool. The text is structured as follows. The next section describes the approach of filter based queries. Section 3 explains the configurable aspects of MQT, both with respect to the metadata scheme, as well as with respect to the graphical user interface. Some details on the queries generated by MQT are presented in section 4. The next section covers some user interface aspects. Section 6 gives an overview of related research and tools. Before concluding, we briefly present the current status in section 7.

2. Filter Based Metadata Querying

The metadata we want to query is stored in the ARIADNE Knowledge Pool System [Forte, Wentland & Duval 1997], which basically is a distributed RDBMS. As we wanted to develop a user friendly query tool, we had to develop a reasonably intuitive mechanism, rather than asking the end user to enter SQL-queries. The approach we adopted in MQT is filter based querying (also called content-based filtering) [Mukherjea & Foley 1995]: users define filters on attributes to impose search criteria. A filter on the document title for instance leads to a search for documents, whose title starts with, ends with or contains a search string.

Available filters are defined in one of the configuration files of MQT. Different types of filters are available for different types of attributes, data types, conditions and functions. [Fig. 1] gives a short overview of the different types and their associated functionalities.

Filter type	*Fields*	*Attribute type*	*Conditions*
Basic	Textbox	String	Starts with, *Contains*, Ends with
		Number	<, <=, =, >=, >
		Date	<, <=, =, >=, >
List	Pulldown	NA	NA
Composed	Panel	NA	NA

Figure 1 : Different filters and their associated functionality

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Basic filters enable the user to search on (sub-)strings, numbers and dates, based on conventional operators. A list filter contains all applicable values for the associated attribute. The relevant values for such a list filter are retrieved from the database when MQT is launched. Composed filters contain basic and list filters, or other composed filters (see below).

At all times, MQT displays a list of all active filters, which can be deactivated through a simple button associated with each filter. This is illustrated by the simplified screen dump presented in [Fig. 4].

3. Configuration

MQT is developed in a general way: it contains no hard coded references to the metadata scheme, in the form of tables or attributes in the database. This is achieved by a configuration file, which defines the metadata scheme (relations, attributes interrelationships between the relations), as will be explained in section 3.1.

Because not all database attributes are useful in search criteria, the query tool also uses another configuration file, which defines the queries to be supported on the database, as explained in section 3.2.

In this way, MQT can be used to query any metadata store accessible through JDBC (see below).

3.1. Data Scheme Configuration File

This configuration file describes the metadata scheme, in the form of its representation as a relational database scheme. It contains all information needed to generate the queries. More specifically, this configuration file includes the following information:

- Database relations
- For each relation:
  - Attributes
  - Primary key
- References between the database relations

[Fig. 2] illustrates the XML representation of this information.

```
<DATAMODEL>
  <ENTITY>
    <NAME> Pedagogical_Header </NAME>
    <ATTRIBUTE>
      <NAME> Id </NAME>
      <TYPE> STRING </TYPE>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <NAME> Document_Title </NAME>
      <TYPE> STRING </TYPE>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <NAME> Package_Size </NAME>
      <TYPE> INTEGER </TYPE>
    </ATTRIBUTE>
    <KEY> Id </KEY>
  </ENTITY>

  <ENTITY>
    <NAME> User_Comments </NAME>
    <ATTRIBUTE>
      <NAME> Comment_Id </NAME>
      <TYPE> INTEGER </TYPE>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <NAME> Header_Id </NAME>
      <TYPE> STRING </TYPE>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <NAME> Author </NAME>
      <TYPE> STRING </TYPE>
      <MULTIVALUED> YES </MULTIVALUED>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <NAME> Comment </NAME>
      <TYPE> STRING </TYPE>
      <MULTIVALUED> YES </MULTIVALUED>
    </ATTRIBUTE>
    <KEY> Comment_Id </KEY>
  </ENTITY>

  …

  <MAINENTITY> Pedagogical_Header </MAINENTITY>

  <MAINATTRIBUTE> Document_Title </MAINATTRIBUTE>

  <REFERENCES>
    <REFERENCE>
      <FROM>
        <ENTITY> User_Comments </ENTITY>
        <ATTRIBUTE> Header_Id </ATTRIBUTE>
      </FROM>
      <TO>
        <ENTITY> Pedagogical_Header </ENTITY>
        <ATTRIBUTE> Header_Id </ATTRIBUTE>
      </TO>
    </REFERENCE>
    …
  </REFERENCES>

</DATAMODEL>
```

Figure 2: Possible data scheme configuration file

The data model of [Fig. 2] first defines a 'pedagogical header', ARIADNE jargon for an educational metadata instance [Forte, Wentland & Duval 1997]. The ARIADNE approach for semantic interoperability in educational metadata is presented in [Forte et al. 1999].

Entities in the configuration file correspond with relations in the database. In the extremely simplified view of [Fig. 2], such an instance contains an identifier (`Id`), a title (`Document_Title`) and the size of the document being described (`Package_Size`). The key attribute of this entity is the identifier. The second entity defines user comments, which consist of an identifier for the comment (`Comment_Id`), the identifier of the

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pedagogical header the comment refers to (`Header_Id`), the author (`Author`) and the content of the comment (`Comment`). The latter two attributes are multivalued. The `<REFERENCES>` section defines the relationship between the user comment and the pedagogical header it refers to.

Besides this kind of information, the configuration file also defines a main relation and a main attribute in this relation. Both of these are used to build the user interface (see below). The main relation is also used to generate queries, which retrieve a result list (list of metadata instances satisfying the search criteria) or a specific metadata instance from the metadata store.

3.1.1. GUI Configuration File

This configuration file describes the attributes the user interface should provide filters for. Filters are logically grouped, so that a well-structured user interface can be constructed. An example GUI configuration file is presented in [Fig. 3].

```
<GUIDATAMODEL>
  <FILTERCATEGORY>
    <DESCRIPTION> General information </DESCRIPTION>
    <TOOLTIP> General information of the document </TOOLTIP>
    <FILTER>
      <NAME> Document title </NAME>
      <ENTITY> Pedagogical_Header </ENTITY>
      <ATTRIBUTE> Document_Title </ATTRIBUTE>
    </FILTER>
    <FILTER>
      <NAME> Language </NAME>
      <ENTITY> Element_Language </ENTITY>
      <ATTRIBUTE> Language_Name </ATTRIBUTE>
      <TYPE> LIST </TYPE>
    </FILTER>
    <FILTER>
      <NAME> User comments </NAME>
      <TYPE> COMPOSITE </TYPE>
      <FILTER>
        <NAME> User comment by </NAME>
        <ENTITY> User_Comments </ENTITY>
        <ATTRIBUTE> Author </ATTRIBUTE>
      </FILTER>
      <FILTER>
        <NAME> User comment </NAME>
        <ENTITY> User_Comments </ENTITY>
        <ATTRIBUTE> Comment </ATTRIBUTE>
      </FILTER>
    </FILTER>
  </FILTERCATEGORY><FILTERCATEGORY>
    <DESCRIPTION> Technical Information </DESCRIPTION>
    <TOOLTIP> Technical information of the document </TOOLTIP>
    <FILTER>
      <NAME> Package Size </NAME>
      <ENTITY> Pedagogical_Header </ENTITY>
      <ATTRIBUTE> Package_Size </ATTRIBUTE>
    </FILTER>
  </FILTERCATEGORY>
</GUIDATAMODEL>
```

Figure 3: Possible GUI configuration file based on the data scheme presented in [Fig. 2]

The simplified configuration file of [Fig. 3] defines two categories of filters, one to query on general information and one for technical characteristics. Both categories are described by tooltips that will be presented to the end user when the mouse is positioned over the category selector (see below).

The general category contains two filters, one to search on document title and one for the language of the document. For each filter, the corresponding attribute in the corresponding entity (i.e. database relation) is defined. Similarly, the filter category for technical data defines one filter, to search on package size.

The general category also contains a composite filter to search on user comments. A composite filter represents a composite metadata field. In this case, the composite filter consists of two sub-filters, to search on the author of a comment and the content of the comment (given by a specific author) respectively.

4. Metadata Queries

The queries generated by MQT can be divided into 2 categories:

1. queries that identify the metadata instances that satisfy the search criteria: the set of these instances is called the result list;
2. queries that retrieve one complete metadata instance from the database.

The query that retrieves the result list is roughly structured as follows:

```
SELECT <key attributes>,<main attribute>
FROM   <main entity>,<relations with active filters on an attribute>
WHERE  <conditions imposed by active filter>
AND    <join conditions for relations in the from-clause>
```

The main attribute values are displayed in the result list (see the lower right area in [Fig. 4]). According to the configuration file of [Fig. 2], this would mean that the document title is shown for each document in the result list. The associated key values are used to retrieve the complete metadata instance from the database upon user request.

Retrieving one metadata instance from the database is somewhat more complicated, mainly because the interrelationships between the database relations can be optional and because there can be multiple

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interrelationships between the same two relations. The basic approach to solve this problem is to execute separate queries for each relevant relation.

5. User Interface

[Fig. 4] displays a screen dump of the user interface of MQT based on the previously given configuration files. In reality many more categories and filters are present. The query window (upper left, with "Document Query" as title) basically enables the end user to activate or deactivate filters. For each attribute, a text box or pulldown menu can be used to indicate the search value and the operator ("starts with", "=", etc.) to be applied.

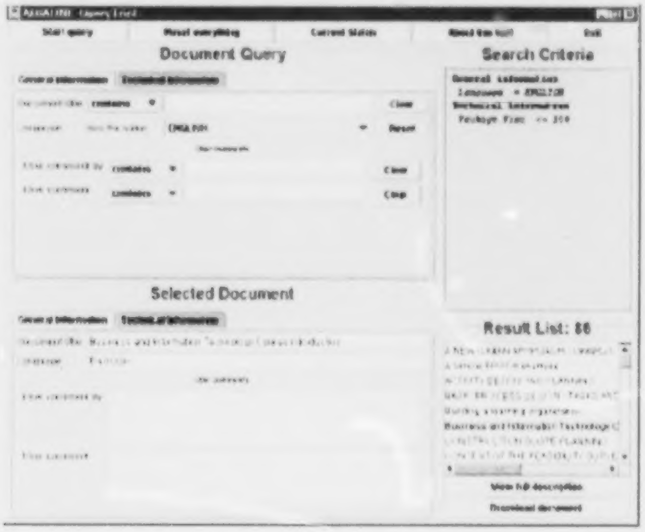

Figure 4: Screen dump of the user interface of MQT given the configuration files of [Fig. 2] & [Fig. 3]

The structure of the query window is identical to that of the data window (lower left, with "Selected Document" title) that displays one particular metadata instance. This was a deliberate design decision, as it makes it more apparent why an instance is included in the result set: the search criteria in the query window can immediately and intuitively be related to the instance values in the data window.

In the upper right area, the active search criteria are displayed in shorthand, so that users have an overview of all active filters at all times. We have added this functionality because of feedback we received on an earlier version of the MQT tool. Without this overview, users quickly lost track of the filters they had applied, and the search values associated with those filters.

Because the number of commands is relatively limited, all commands are available by buttons. Buttons for general commands are situated at the top of the window. These enable an end user to:

- start the query: this means that the query is actually sent to the database, processed, and that the result list is displayed;
- reset everything: all active filters are deactivated and the results list is re-initialized as an empty result list;
- current status: displays the database that MQT is connected to;
- about this tool: provides information about the goal and purpose of the tool;
- exit: the MQT application exits.

Those commands that operate on one specific metadata instance are placed under the result list, as users must select such an instance from that list before applying the command. These commands enable an end user to:

- view the complete metadata instance;
- download the actual document described by the metadata: this command prompts for a user identifier and a password, as only metadata are publicly accessible, but the actual documents are restricted to members of the ARIADNE user group <http://ariadne.unil.ch> (if they are free).

The GUI configuration file (as given in [Fig. 3]) defines the exact layout and configuration of the different graphical components. A filter category in the configuration file corresponds with a Tab panel in the query and

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the data window. A filter in the configuration file corresponds with a graphical component in the query window that enables the user to activate/deactivate the filter, as well as with a graphical component that displays the value of a metadata instance in the data window. The type of the graphical component depends on the filter type and the type of the corresponding attribute. The filter type defines the layout and the attribute type determines the available operators.

A composite filter in the GUI configuration file results in a bordered graphical component, which contains the graphical components of the participating filters. The main entity and main attribute are used to indicate the metadata instances that satisfy the search criteria in the result list.

6. Related Research and Tools

Related research can be divided in three different categories: metadata query tools, other query tools (subdivided into XML and web query tools) and general metadata tools.

1. The field of metadata querying is still in full development and not many tools are available. All of the existing metadata query tools we could find either operated on a fixed metadata scheme (Dublin Core, ...) or used some "external" protocol for communicating with the data store (e.g. QUANTUM [Hindall & Haines 1997] uses Z39.50 for querying the database(s)). MQT has no fixed metadata scheme, but it does use JDBC (and SQL) for communicating with the data store.

2a. Since the data scheme configuration file (see [Fig. 2]) can easily be transformed into an XML-DTD, MQT is closely related to XML query tools. XML querying recently became very popular and the ongoing research looks very promising, but it's still in its infancy. One example of such a tool is Innerview <http://www.t2000-usa.com/>, but there still is no uniform, standardised query protocol and mechanism. This might change quickly as some proposals already exist [XML-QL 1998] [XQL 1998].

2b. One more developed research area concerns web querying. There are a lot of sophisticated web search engines available, but there exists no uniformity amongst different tools and the documents on the web don't comply to a standardised, uniform indexing method so that it's very hard to find what you're looking for. This could be facilitated by the use of metadata, but since this is not standardised for the web, web search engines use keywords indexing (and a fixed user interface).

3. Finally, there are general metadata tools. There is one tool in particular we took as a starting point in our design: Reggie [Reggie 1999] is a metadata insertion tool. It uses an input scheme (which ranges from Dublin Core to your own defined scheme) to describe its metadata set and builds its user interface (and associated functionality) based on the selected scheme. Contrary to MQT, Reggie is used to describe data (that is to insert metadata) and it is developed as an applet.

7. Current Status

During the development of MQT, we were confronted with the classical trade-off between functionality and user friendliness. We tried to keep the user interface as intuitive as possible while still supporting quite powerful search possibilities. The user interface also has its limitations though: the result list displays only one attribute for every hit,...

MQT supports any possible combination of active filters, but its functionality is limited in some ways. One of the main limitations is that only the logical 'and' operator is used in the queries: this means that it is impossible to search for documents, whose title starts with 'Behind the scenes' or 'A closer look at'. On the other hand, usability-engineering research consistently shows that users have great difficulty to use boolean operators in the correct way [Shneiderman 1998].

As mentioned before, MQT has been developed in the first place as a query tool for educational metadata in the ARIADNE project [Forte, Wentland & Duval 1997]. All metadata in ARIADNE are stored in a relational database, mainly because of technical reasons [Cardinaels et al., 1998]. MQT is a Java application that uses JDBC to interact with the database. The decision to use a Java application and not an applet or servlet is based on several factors:

1. Servlets generate HTML. Given the current limitation of HTML browsers, this is not a sound development base for an intuitive and powerful user interface.
2. Because of security restrictions, applets cannot communicate with databases that run on servers different from the one that serves the applet.

Java interfaces have been defined for different kinds of filters (see above), attribute types and conditions, so that it is relatively easy to extend the functionality of MQT by adding a new type of filter, attribute type or condition.

Since early 1999, MQT has been deployed within the ARIADNE community and is being used by several hundreds of persons. Based on feedback received in first user trials, we have added the "Search Criteria" window, as mentioned above. Other feedback indicates that this tool indeed serves its major purpose and does enable end users to zoom in fairly quickly on relevant reusable educational resources.

Future work includes the migration from a 2-tier to a 3-tier architecture and the use of introspection of classes in the middleware layer to enable an automatic configuration of the tool.

8. Conclusion

One of the main requirements for the metadata query tool in the Ariadne project [Forte, Wentland & Duval 1997] was that the metadata scheme should not be hard coded, as we wanted to develop a tool that was flexible enough to query metadata stores with different metadata schemes. Using XML configuration files describing the metadata scheme and the required query functionality provided us with the flexibility we wanted to achieve.

Our query approach relies heavily on refinement, through filter based querying. A user can activate and deactivate filters over attributes. Currently, our tool supports basic filters, list filters and composite filters, but new filter types can easily be incorporated.

The approach discussed in this paper leads to a generic query tool, which can be used to query any kind of metadata in any kind of store that can be accessed through JDBC.

9. References

[Cardinaels et al. 1998]	K. Cardinaels, K. Hendrikx, E. Vervaet, E. Duval, H. Olivie, F. Haenni, K. Warkentyne, M. Wentland Forte & E. Forte. A Knowledge Pool System of Reusable Pedagogical Elements. *Proceedings of CALISCE98 - 4th International Conference of Computer-Aided Learning and Instruction in Science and Engineering*, pp. 54-62.
[Forte et al. 1999]	E. Forte, F. Haenni, K. Warkentyne, E. Duval, K. Cardinaels, E. Vervaet, K. Hendrikx, M. Wentland Forte & F. Simillion. Semantic and Pedagogic Interoperability Mechanisms in the Ariadne Educational Repository. *Accepted for a SIGMOD Record Special Issue on Semantic Interoperability in Global Information Systems*, 1999.
[Forte, Wentland & Duval 1997a]	E. N. Forte, M. H. K. Wentland Forte & E. Duval. The ARIADNE project (partI) - Knowledge Pools for Computer Based & Telematics Supported Classical, Open & Distance Education. *European Journal of Engineering Education*, Vol. 22, No. 1, pp. 61-74.
[Forte, Wentland & Duval 1997b]	E. N. Forte, M. H. K. Wentland Forte & E. Duval. The ARIADNE project (partII) - Knowledge Pools for Computer Based & Telematics Supported Classical, Open & Distance Education. *European Journal of Engineering Education*, Vol. 22, No. 2, pp. 153-166.
[Hindall & Haines 1997]	M. H. Hindall, M. Haines. QUANTUM: A Query and Analysis Tool For Use With Metadata. *Proceedings of the Second IEEE Metadata Conference*, 1997. http://www.computer.org/conferen/proceed/meta97/papers/mtindall/mtindall.html
[Iannella & Waugh 1997]	R. Iannella , A. Waugh. Metadata: Enabling the Internet. *Proceedings of CAUSE97 – "The Information Professions and the Information Professional"*. <http://archive.dstc.edu.au/RDU/reports/CAUSE97/>
[Mukherjea & Foley 1995]	S. Mukherjea & J. D. Foley. Visualizing the World-Wide Web with the Navigational View. *Electronic Proceedings of the Third International World-Wide Web Conference (WWW '95)*, 1995. <http://www.igd.fhg.de/www/www95/papers/44/mukh/mukh.html>
[XML-QL 1998]	A. Deutsch, M. Fernandez, D. Florescu, A. Levy, D. Suciu. XML-QL: A Query Language for XML, Submission to the World Wide Web Consortium, 19 August 1998. <http://www.w3.org/TR/NOTE-xml-ql>
[XQL 1998]	J. Robie, J. Lapp, D. Schach. XML Query Language (XQL). <http://www.w3.org/Style/XSL/Group/1998/09/XQL-proposal.html>
[Reggie 1999]	Reggie: The Metadata editor. <http://metadata.net/dstc/>
[Shneiderman 1998]	Ben Shneiderman. *Designing the User Interface. Strategies for Effective Human-Computer Interaction.* Addison-Wesley, 1998. <http://www.aw.com/DTUI>

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Feasibility of the Internet in Collaborative Networks in Learning Communities.

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Abstract: This paper is proposed to discuss the feasibility of the Internet in collaborative networks in learning communities. Referring to the international trends in developing learning communities and educational Internet, the author analyses advantageous and disadvantageous conditions for the usage of the Internet in community collaborative networks. The literature linking to practical experience and an experimental project mainly in the context of Taiwan is reviewed. Six strategies are finally raised as recommendations for promoting the feasibility of the Internet in learning communities.

Introduction

Setting up a learning society has been a popular target of education innovation in many advanced countries after the 1990s [Cresson, 1995; Van der Zee, 1991; Williamson, 1995]. In Taiwan, the Ministry of Education announced the year, 1998, to be the Lifelong Learning Year and published a White Paper called "Approaching towards a learning society", like the 1996 European Lifelong Learning Year. Twelve action projects in the White Paper have been carrying out [Ministry of Education, 1998]. A learning society is a lifelong learning society composed of diverse sub-organisations such as families, communities and different groups. Although the conception [Field, 1996; Jarvis, 1997] and the targeted group [Macrae, Maguire and Ball, 1997] of a learning society are still on debates, the significance of community in a learning society has been shown [Chapman and Aspin, 1997; Hemphill, 1996; Vincent, 1993]. As McNain [1999] stresses, learning is rooted in communities. Therefore, how to develop learning communities that can be seen as fundamental sub-organisations of a learning society is crucial. That is the reason why the Ministry of Education of Taiwan has programmed five communities to conduct the experiments of developing learning communities.

A learning community is a community where various learning resources are integrated to form a learning network. As Edwards [1995] points out, a learning society is as a learning network in which residents can pick up learning resources available to achieve their diverse targets. A learning network is formulated by different stakeholders working collaboratively as partners. Hence, how to enhance the collaboration between different stakeholders is an important issue for developing learning networks. For beneficial collaboration, there are necessary costs to be paid [Coffey, et al, 1988; Fox and Faver, 1984] by collaborators. The critical point will be how to conduct collaboration successfully to run learning communities. Namely, a successful partnership is demanded in a collaborative network of learning community [Friendstein, 1995]. Stakeholders who are included in collaborative networks can directly influence the function of learning communities.

In Taiwan, the total value of production of information technology has been occupying the third place in the world, just behind the USA and Japan. The Government has realised the importance of development and application of information technology in learning. The National Information Infrastructure (NII) was announced and a number of projects have been in implementation. In NII, how to apply the Internet is proposed as a significant part. The necessary equipment of information technology has been gradually enriched for educational providers like compulsory schools in communities. Linking to the implementation of lifelong learning in communities, the NII is helpful for the development of collaborative learning networks.

In this paper, the author will discuss how the Internet can be used in collaborative networks in learning communities. In addition to the literature review, empirical data and experience collected from a city community, one of the experimental communities supported by the Ministry of Education will be also included to reveal the practice in the real world. This approach is like an action research. The author will analyse relevant advantageous and disadvantageous conditions in terms of the application of the Internet in collaborative networks in learning communities and then raise recommendations for improve the current situations.

Advantageous conditions for applying the Internet in collaborative learning networks

Advantageous conditions mean that these conditions are beneficial for using the Internet. They are in different dimensions and the followings are the major ones.

The central Government's promotion via its policy agenda

The principal advantage of the central Government's policy is that it can conduct its influence through the administrative system from central to local via remit powers. Additionally, the necessary budgets can be provided and have a comparatively stable financial support. For example, Taiwan's Ministry of Education and Ministry of Information and Transportation, which is in charge of the project of NII in the central Government, have a close relationship with the use of the Internet. The Ministry of Information and Transportation enriches computer facilities in communities and the Ministry of Education is devoted itself in promoting lifelong learning and information education via their policy agendas. Both Ministries have direct contributions to the application of the Internet in hardware and software equipment.

A larger popularity in the Internet usage

In Taiwan, there have been getting more people who use the Internet for different purposes. Taiwan's production of information technology plays a crucial role in the world. For example, in 1996, Taiwan's production of notebook pc (occupies 28% in the world market), monitor scanner (61%) and mouse (80%) were all in the first place in the world market [Young, 1996]. The achievements have paved a smooth way for utilising the Internet. A larger popularity in the Internet usage is helpful to enlarge its potential functions in collaborative learning networks. According to a recent global investigation, Taiwan's ratio of the Internet users in its whole population was 14.30%, which was the 12th place in the world [The Liberty Times, 1999]. In Asia, the ratio was higher than in Japan, South Korea, and Hong Kong. Both Taiwan and Singapore had the largest density of the Internet users in Asia.

Adequate computer facilities in community compulsory schools

Computer facilities are needed for application of the Internet. With the supports of the Ministries of Education and of Information and Transportation, computer facilities in compulsory schools have been greatly upgraded. Compulsory schools here mainly include public primary and junior high schools. Their chief strength in collaborative learning networks is that they are widely located in communities and have stable budgets from the local government. Since the popularity of pc is insufficient for most families, computer facilities in compulsory schools are therefore quite helpful for people in communities to use. For opening the resources of compulsory schools to their communities, the educational authorities have been planning remit regulations to schools.

A greater information literacy for all

Compared with their counterparts in the past, younger generations in Taiwan have higher information literacy, partly because of the success of information education in schools and partly because of the trend of information society. For applying the Internet, although the hardware equipment is necessary, the software one is much more significant. Internet users' information literacy is a crucial condition for a successful usage of the Internet. A good sign is that there are more young people who can learn basic literacy of information technology in different levels of schools. For older generations, they have more opportunities to improve their information literacy via adult education. The advancement of information literacy for all is a good basis for enlarging the use of the Internet.

More educational providers in communities

With the development of adult education and lifelong learning, there have been much more educational providers who can offer learning resources in communities. Compulsory schools have played an important role in learning communities but they are not the only educational provider. The others are like libraries, museums, profit and nonprofit organisations, enterprises, clubs, community groups and so forth. They are all potential providers of education according to their availability. The increase of potential educational providers in many different communities lays a strong background for using the Internet. For a learning community, a working collaborative learning network is significant to construct its framework. The appearing educational providers increase the possibility of forming a collaborative network in community.

Disadvantageous conditions for applying the Internet in collaborative learning networks

Besides the above advantageous conditions for applying the Internet, there are disadvantageous conditions that can affect the usage of the Internet. These conditions also come from many different respects. The followings are the obvious ones.

The lack of a concrete framework of a learning community

A concrete learning community is still in experiment in Taiwan. In terms of the conception of the learning community, actually, it is in development even in the main advanced countries. The lack of literature and empirical experience relating to a learning community will affect the development of collaborative networks. One of the obvious drawbacks is that the context of a learning community is not clear enough to provide a fundation of the framework. Additionally, the stakeholders inside are difficult to be identified. It is harmful to distribute the responsibility and share tasks for collaboration. The messy situation results in that the framework of a learning community is still ambiguous.

The lack of any mature collaborative network in communities

Although there have been more potential educational providers in many Taiwan's communities, a mature collaborative network is still not available. Many current educational providers do not know fully that they can play a more significant role in learning communities. Many community institutes that are not set up originally for educational purposes have not recognised yet that they can have functions in educational services. It is still insufficient that there are different educational providers who are collaborating successfully in communities. There is rare successful experience in a mature collaborative network. In many communities, potential educational providers are still pretty not sufficient. The problem of inequality of resource distribution in Taiwan's communities is still obvious.

The lack of a recognition system for learning

A recognition system that can be used to certificate people's learning is crucial for developing collaborative networks in learning communities. In Taiwan, although like the Learning Passport is in development, the lack of a recognition system is an obstacle for people to learning in their communities. Their motivation of participation in continuing learning in community therefore will be affected. A recognition system is not only a stimulus but also a link for people's learning. No matter which kind of learning track people involved, formal, nonformal or informal, their results of learning need to be recognised and accumulate to be their achievements in learning for various purposes like employment and academic upgrade. The absence of this stimulus and link will decrease the possibility of developing collaborative networks.

The lack of professional lifelong education sectors and educators in communities

There are potential stakeholders who can be collaborators in communities but for a better quality of service, the standard of profession has to be advanced. In current Taiwan's communities, except local primary and junior high schools, there is no sufficient professional lifelong education sector and educator. At present, potential community sectors to be collaborators such as social education institutes, libraries, museums, community centres and other private organisations are not professional enough. Lifelong learning is unfamiliar for most of their members. Even teachers in local schools are not necessary with adequate professional literacy to conduct their role in lifelong education. There are only four relevant graduate institutes of adult education in Taiwan to provide professional education and training. In-service education and training via educational institutions is still not sufficient and that is not helpful for the improvement of educational services.

The lack of effective legislation

Legislation is the guideline and basis of administration. For working collaborative networks in learning communities, sufficient legislation is needed. It can be the basis of developing learning communities. It can also be the guideline to lead the administrative operation of the different levels of governments. Since the unavailability of legislation, current Taiwan's central Government's guides and involvement in developing collaborative networks are in a mess and cannot have efficient effects. The unavailability of legislation is also the major reason why people's learning results cannot be recognised. Legislation can also serve as a protector for collaborators in learning communities. It can be a basis of collaboration and a guideline for potential collaborators' working together through the rules of how to share responsibilities and obligations.

The way to go

For developing collaborative networks in which the Internet can be fully used in learning communities in Taiwan, there have been advantageous conditions to be the facilitating factors and disadvantageous ones to be clean out. Taiwan's educational authorities and relevant stakeholders need effective strategies to pave the way to achieve the above target. Six strategies are raised below to be the recommendations.

Enacting necessary acts and regulations

Enacting necessary acts and regulations are critical for a stable development of collaborative networks

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in learning communities. The efficiency of legislation is low in Taiwan's Legislative Yuan. It is necessary to enact acts and regulations according to different levels of legislation. A national act is demanded for the use at national level and its procedure through the Legislative Yuan is required. The progress will be slow and it is difficult to say when it can be finished. If it is not necessary to go into the procedure in the Legislative Yuan, the regulations can be developed in responsible administrative departments with a comparatively higher efficiency. The Ministry of Education has to classify the needed legislation on basis of their levels and priorities. For regulations that do not have to be passed in the Legislative Yuan, the Ministry has to formulate as soon as possible or empowers its lower level departments to accomplish. For instance, the regulations regarding the open-door policy of local schools' computer facilities can be formed by schools themselves under the guidance of the local educational authorities.

Developing local school-based collaborative networks

The potential contributions of local primary and junior high schools have to be fosterd further. Schools can be the centres for a learning community [Chapman and Aspin, 1997]. Due to their universality, these local schools have to get themselves much more involved in collaborative networks. For that, current acts have to be revised and relevant regulations have to be enacted. To formulate legislative responsibilities and obligations is necessary to develop local school-based collaborative networks. Legislation also needs to regulate how to evaluate, for rewards or punishments, their involvement in the networks. Especially, when required professional lifelong educators and learning resources are insufficient, local schools have to play a greater part. Educators including principals, school administrators and teachers need in-service education and training to enrich their knowledge and skills to conduct their contribution to the collaborative networks in community. They can be the leaders for new learning communities, as Castle and Estes [1995] recommend.

Expanding the use and popularity of the Internet

The use and popularity of the Internet have to be increased in Taiwan. Based on the achievements in NII and information technology, the Internet can become much more familiar to different users, especially in disadvantaged arena. For serving users who have been active visitors of the Internet, the responsible Government's departments have to help them conquer the possible barriers on the Internet such as the space of link and speed of operation. Their strong motive needs to be kept for continuing use of the Internet. For new and potential users, extensive courses of information literacy are needed to increase the possibility of their usage. In disadvantaged arena, extra supported resources are demanded. Special approaches like computer or Internet buses to countryside will be helpful.

Designing a system for accreditation of learning

A system that has legislative effectiveness for accrediting people's learning results is strongly demanded. The progress of experimenting Lifelong Learning Card or Passport has to get faster. Its merits or shortcomings are valuable for designing a system for accreditation of learning. The experimental usage in Taipei has started. For a national use, Taipei's experience can be referred to develop a national card or passport. No matter a Card or a Passport, it is a link of personal different types of learning. For its application, a system for accreditation of learning is required. The system should be developed on the basis of a multiple discussion process to form a consensus and to design its detailed contents. A comprehensive and broad recognition is very significant to enlarge the utility of the above Card or Passport. The system has to cover at least three types of learning ie formal, nonformal and informal tracks. Particularly, it is able to encourage individual's self-study and recognise the learning results for different purposes.

Enriching the achievements of the experiments of learning community

A collaborative learning network is rooted in a learning community. It is important to make the conception of a learning community as concrete as possible. The results of the five experimenting learning communities have to be carefully assessed for an extensive application. After the experiments have been conducting, the issue of developing collaborative networks can be a research question to be answered. Actually, it is impossible to ignore the role of different stakeholders in communities. A collaborative learning network is a place where stakeholders can get themselves involved. Thus, when the experiments have been carrying out, there can be valuable findings coming out, which are able to contribute to the formulation of collaborative networks.

Programming an encouraging system to have more key stakeholders

The involvement and participation of different stakeholders in learning communities has to be encouraged. As Rutledge, Swirpel and Tray [1996] suggest, networking is a significant step for the learning community. To find out the key stakeholders to form the networking is a critical task. For different stakeholders, some of them have stature obligations to take part in the collaborative networks. But, for the others, usually private organisations, may not have the remit responsibility. Their participation is based on their availability in intention and resource. No matter which kind of stakeholders, the Government's encouragement is helpful, especially for those who have no legislative obligation. The governmental institutions have to be the models to lead the involvement of private partners. Necessary supporting resources, financial or spiritual, are needed from the responsible governmental departments whose powers can be regulated in relevant legislation. For example, local public schools have to actively invite other stakeholders in community to set up a partnership.

The above strategies are recommendations that can be used to enlarge the contributions of advantageous conditions and delete the influences of disadvantageous ones for developing collaborative networks via the Internet in learning communities. They cover many tasks in different dimensions for diverse stakeholders.

Conclusion

Collaborative networks can not appear unless the necessary conditions are already available. Hence, it is crucial to analyse different conditions, including helpful and harmful, to see how to formulate the networks. For achieving a lifelong learning society, collaborative networks can play a critical part. When there have been five learning communities in experiment and a growing usage of the Internet in Taiwan, it is a good time to develop collaborative networks inside. From collaborative networks and learning communities to a learning society through the application of the Internet is a direct and necessary road. There have been advantageous conditions in Taiwan, which are helpful to pave the way. But, there have been also disadvantageous conditions, which are barriers on the way. The author has analysed these two groups of conditions and raised strategies as recommendations to enlarge the potential contributions of advantageous conditions and delete the possible impacts of disadvantageous ones. The author's vision is to establish a lifelong learning society, which has been the focus of Taiwan's educational innovation and an international trend of educational development. For achieving the vision, the Internet is playing a critical role via the collaborative networks in community.

References

Castle, D. K. and Estes, N. (1995). *High-performance learning communities.* Thousand Oaks, California: Corwin Press, Inc.

Chapman, J. D. and Aspin, D. N. (1997). *The school, the community and lifelong learning*. London: Cassell.

Coffey, J. et al. (1988). *Commonwealth cooperation in open learning*. Summary report. London: Commonwealth Secretarial Publications.

Cresson, E. (1996). The European Year of Lifelong Learning. *Adults Learning, 7*(9), 215-218.

Edwards, R. (1995). Behind the banner: whither the learning society. *Adults Learning, 6*(6), 187-189.

Field, J. (1996). Universities and the learning society. *Adults Learning, 35*(1), 1-12.

Fox, M. F. and Faver, C. A. (1984). Independence and cooperation in research: The motivations and costs of collaboration. *Journal of Higher Education, 55*(3), 347-359.

Friedstein, H. G. (1995). Community college 2000: Focus on local, national and international partnerships. *Community College Journal of Research and Practice, 19*, 331-340.

Hemphill, D. F. (1996). Flexibility, innovation and collaboration: A regional view of community-based organisations in adult education. *Adult Learning, 7*(6), 21-22.

Jarvis, P. (1997). *Paradox of the learning society.* Paper presented at international conference of lifelong learning: Reality, rhetoric and public policy. 4-6, July, 1997. Surrey, England: University of Surrey.

Macrae, S., Maguire, M. and Ball, S. (1997). Whose "learning society"? A tentative deconstruction. *Journal of Education Policy, 12*(6), 499-509.

McNair, S. (1994). From worthy margin to lively mainstream. *Adults Learning, 10*(5), p. 3.

Ministry of Education (1998). *Approaching towards a learning society.* White Paper. Taipei: The Ministry of Education.

Rutledge, C. M., Swirpel, D. J. and Tracy, J. C. (1996). The learning community: A pro-family system of education and community support. *Adult Learning, 7*(6), 9-10.

The Liberty Times (1999). *Taiwan's ratio of the Internet users occupies the 12th place in the world.* 1999. 1. 30. P. 30.

Van der Zee, H. (1991). The learning society. *International Journal of Lifelong Education, 10*(3), 213-230.

Vincent, C. (1993). Education for the community? *British Journal of Educational Studies, 41*(4), 366-380.

Williamson, A. (1995). Australian as a learning society: Issues, trends and prospects. *Australian Journal of Adult and Community Education, 35*(1), 3-12.

Young, I-Lee (1996). Heroes in technologies. *CommonWealth, 182*, 26-34.

Designing Multimedia and Web-Based Units for Technology Integration: Motivation and Student Learning Styles

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Abstract: This study, in the absence of a literature foundation on implementation of the National Educational Technology Standards and the use of new technologies to supplement traditional methodologies in teaching technology competencies, was designed to explore the influence of multimedia and web-based supplements on various learning styles and student motivation. Seventy-five undergraduate education majors in four Applied Educational Technology Courses were administered both Honey and Mumford's Learning Styles Questionnaire and Roedel's Goals Inventory at the beginning of the course. The students were also given the Goals Inventory at the conclusion of the course. Since this study is still in its infancy, the results from an initial pilot study and preliminary data analysis will be presented at WEBNET. The development of the shocked multimedia unit to be delivered via the World Wide Web, the instrumentation and research methodology will also be presented.

Introduction

According to the research by Sheingold & Hadley [1990], as well as many others, it takes an average of five years before teachers feel in command of new technologies and know: (a) how to use them; (b) when to use them; (c) how to assess their benefits; and (d) how to evaluate the usefulness of new technologies in the curriculum. However, national accrediting bodies are pushing for rapid integration of technology in teacher education. Consequently, faculty in teacher preparation programs are looking for new methods for helping their students acquire knowledge and skills to meet the recommended technology standards. Advocates of new multimedia and web-based technologies argue possible benefits of such technologies include increased intrinsic motivation, and the opportunity for students to learn in their own "style" and at their own "pace". An additional argument is that interactive multimedia and web-based materials provide media and visually rich material that is more likely to correspond effectively with students' individual learning "styles" [Crosby & Stelovsky 1995].

Goal Orientations

Educators are confronted on a daily basis with students who lack the necessary motivation to be successful in school. This has been a recurring concern in public education. The 1989 Gallup/Phi Delta poll of teacher attitudes showed lack of student interest as one of the top four mentioned programs in teaching [Elam 1989]. Student apathy and lack of motivation are also a concern in college age students [Cohen 1991; Cubbison 1993]. Recently, the study of students' goal orientations, or goal theory, is an area of student motivation that has drawn considerable interest. The goal orientation construct focuses on the types of learning goals that students adopt in academic situations [Ames 1992].

In referring to goal orientations, Ames [1992] defines achievement goals as an "integrated pattern of beliefs, attributions, and affect that produces intentions of behavior" and further adds, "that is represented by different ways of approaching, engaging in, and responding to achievement-type activities" [p. 261]. The two goals that have received the most attention are mastery and performance goals. The following definitions of the mastery and performance orientations are based on descriptions proposed by Dweck and Leggett [1988].

Students who are oriented toward learning goals (i.e., mastery goals) are interested in learning new skills, improving their understanding and competence, and utilizing self-regulatory strategies. These students are concerned with improving their ability, and they seek challenges in the learning process. Therefore, mastery goals are concerned with actual learning and understanding. Individuals with mastery goals believe that competence is malleable and controllable, are more likely to be intrinsically motivated to learn, view errors as opportunities to learn, and persist in the face of failure.

In contrast, students who orient towards a performance goal perspective are more concerned with proving their ability. These students are concerned with being judged able. Further, they believe that competence is a stable characteristic, are not as likely to be intrinsically motivated, view errors as a sign of failure, and give up easily when they fail. These students avoid opportunities for challenge.

The following are some of the achievement behaviors of elementary age students that have been associated with each goal orientation [Dweck 1986 & Dweck & Leggett 1988]. Students with mastery goals seek out challenge and persist in the face of difficulty. These students view errors as opportunities to learn, to increase their effort, and restrategize. Children are focused on effort needed to successfully complete a task and experience pride with their accomplishment. Therefore, they see competence as malleable. They choose challenging tasks even if they perceive their ability for those tasks to be low. These students are more likely to be intrinsically motivated to learn. In contrast, students with performance goals see intelligence as a fixed trait. They tend not to select challenging tasks in an effort to avoid negative evaluations. They are less likely to be intrinsically motivated to learn. Satisfaction is based on the ability they have displayed rather than the effort involved to achieve mastery. These students are focused on issues of ability. Errors indicate failure and lack of ability. Therefore, they tend to withdraw when they encounter these obstacles.

Most recently, research has begun to clarify the relationship between goal orientation and achievement behaviors with older students. In the college context [Archer 1994; Hagen & Weinstein 1995; Jagacinski & Nicholls 1987; Pintrich & Garcia 1991] investigations have led researchers to conclude that students in the college context are probably using both goal orientations simultaneously. The mere presence of performance goals does not necessarily lead to maladaptive achievement behaviors as long as mastery goals are salient. However, it is still the adoption of mastery goals that leads to the most beneficial achievement behaviors, and the thrust of this research still emphasizes the superiority of mastery goals. The findings from the studies that have been conducted in the secondary schools produce similar conclusions [Ainley 1993; Ames & Archer 1988; Wentzel 1989].

While this goal orientation theory of motivation has more recently been used in the study of student achievement in traditional college and university classrooms, it may also provide valuable insight into teacher education programs that choose to employ the use of high-quality, multimedia and web-based course supplements in addition to traditional teaching methodologies. The use of such multimedia technologies in teacher education has recently increased due to the availability of user-friendly courseware design software, the relative ease-of-use of the internet, and the push from national accrediting bodies such as the International Society in Technology Education, to train pre-service teachers in the integration of technology in their classrooms.

Student Learning Styles

The capability of multimedia and web-based technologies may in fact allow the instructor and the student to adapt teaching and learning strategies to enhance instruction. Such technologies can be used to provide numerous learning activities that represent each of the four dominant learning style categories as proposed by Honey and Mumford [1986]. The learning styles, in no order of importance, are: (a) activist; (b) reflector; (c) theorist; and (d) pragmatist. Activists involve themselves fully and without bias in new experiences. They enjoy the here and now and are happy to be dominated by immediate experiences. They are open-minded, not skeptical, and this tends to make them enthusiastic about anything new. They tackle problems by brainstorming. Reflectors like to stand back to ponder experiences and observe them from many different perspectives. They collect data, both first hand and from others, and prefer to think about it thoroughly before coming to any conclusion. Their philosophy is to be cautious. They are thoughtful people who like to consider all possible angles and implications before making a move. Theorists adapt and integrate observations into complex but logically sound theories. They think problems through in a vertical, step by step logical way. They assimilate disparate facts into coherent theories. They tend to be perfectionists who will not rest easy until things are tidy and fit into a rational scheme. Pragmatists are keen on trying out ideas, theories and techniques to see if they work in practice. They positively search out new ideas and take the first opportunity to experiment with applications. They respond to problems and opportunities as a challenge.

Consequently, this study utilized Honey and Mumford's questionnaire to predetermine students' preferred learning styles. This data produced by the administration of the questionnaire allowed the researchers to correlate individual learning styles with each multimedia, web-based instructional unit developed by the researchers to enhance students' skills and knowledge in the use and integration of technology in one introductory college-level course on educational technology. This required course is part of a teacher preparation program.

Development of Multimedia, Web-Based Instructional Units

In conjunction with this study, several multimedia and web-based instructional units on the introduction to educational technology were developed by the principal investigators using Macromedia's Authorware and Director software programs These multimedia units were designed to help students meet the National Educational Technology Standards (NETS) for all students (International Society for Technology in Education, 1999). The technology foundation standards for students are divided into six broad categories including: (1) Basic operations and concepts; (2) Social, ethical, and human issues; (3) Technology productivity tools; (4) Technology communication tools; (5) Technology research tools; and (6) Technology problem-solving and decision-making tools. Standards within each category are to be introduced, reinforced, and mastered by students.

The multimedia units were also designed to incorporate each of the four learning style categories identified by Honey and Mumford including: (a) Activist; (b) Reflector; (c) Theorist; and (d) Pragmatist. Activists involve themselves fully and without bias in new experiences. They tend to act first and consider the consequences afterwards. Reflectors like to stand back and ponder experiences. They postpone reaching definitive conclusions for as long as possible. Theorists think through problems in a vertical step by step way. They tend not to rest easy until things are tidy. Pragmatists try out ideas, theories, and techniques to see if they work in practice. They take the first opportunity to experiment with applications.

Purpose

This study, in the absence of a literature foundation on implementation of the National Educational Technology Standards and the use of new technologies to supplement traditional methodologies in teaching technology competencies, was designed to explore the influence of such multimedia and web-based supplements on various learning styles and student motivation.

Methodology

Participants

The participants were 75 undergraduate education majors in 4 sections of an undergraduate educational technology course entitled "Applied Educational Technology" at a southeastern university. This course employs a systems approach to using traditional and emerging technology in instruction. Its emphasis is upon the integration of instructional design principles with uses of technology as instructional tools to enhance the quality of classroom instruction and to facilitate the work of the teacher.

Data Collection

Data are to be collected using 2 instruments: (1)The Goals Inventory (Roedel et al., 1994); and (2) Honey and Mumford's Learning Style Questionnaire (1986). This Goals Inventory is designed to measure older students' mastery and performance orientations. It contains 25 items using a 5-point Likert scale for each item. It has two scales, and it yields two separate continuous scores. One represents an individual's score on the mastery orientation, and one represents a score on the performance orientation. These two scales are statistically independent and are uncorrelated. Roedel et al. report respectable reliability and validity estimates for this instrument. The test-retest reliability estimates for the mastery and performance scales were r=.73 and r=.76 respectively. Internal consistency estimates were .80 and .75 respectively, using Cronbach's alpha. Adequate convergent and divergent validity conclusions were supported by comparing this instrument with other important constructs. The Goals Inventory takes approximately seven minutes to complete.

The Learning Styles Questionnaire is a self-administered questionnaire consisting of eighty, single sentence questions and is grounded in Kolb's theory of a four stage process of learning. This learning style inventory like most others, was developed to help a person discover general trends or tendencies that run through his/her behaviors, without placing undue significance on any item. The LSQ was designed to identify the relative strengths of four different learning styles.

Both instruments will first be administered in August, 1999. Participants will have a choice of how to complete the survey. The survey will be posted on the Internet and will also be available in a traditional paper and pencil format. The questionnaire available on the web site will be linked via an active server page to a Microsoft Access database. When submitted by the participants, the data will automatically be entered and filtered in the database. The Goals Inventory will be administered in a pre-post format and thus will also be administered upon the completion of the fall semester, circa December, 1999. For the purposes of this proposed paper session at WEBNET, preliminary data will be presented.

Courseware Use

Students enrolled in 2 of the 4 sections of the educational technology course will complete assigned units on the previously identified multimedia interactive introduction to educational technology in addition to traditional classroom instruction and use of a textbook. Students enrolled in the other 2 sections of the educational technology course will not have access to the multimedia materials. All of the sections will be taught by the same instructor using the same teaching methodologies, content, and materials.

Results

For the purposes of this presentation, the results from an initial pilot study and preliminary data analysis will be included. The development of the shocked multimedia unit to be delivered via the World Wide Web, the instrumentation and research methodology will also be presented. A more detailed description of the results of this study will be included in a full paper to be handed out during the WEBNET conference.

References

Ames, C. (1992). Classrooms: Goals, structuresa, and student motivation. *Journal of Educational Psychology*, 84 (3), 261-271.

Cohen, D.A. (1991). Overcoming student apathy and bewilderment: Setting an example of responsibility and attentiveness. *Proteus*, 8(1), 27-29.

Crosby, M.E. & & Stelovsky, J. (1995). From multicultural instruction to multimedia evaluation. *Journal of Educational Multimedia and Hypermedia*, 4 (2), 147-162.

Cubbison, P. (1993). *A is for apathy*. Paper presented at the Annual Meeting of the American Historical Association, San Francisco, CA.

Elam, S. M. (1989). The second gallup/phhi delta kappa poll of teachers' attitudes toward the public schools. *Phi Delata Kappan*, 70 (10), 785-798.

Honey, P., & Mumford, D. (1986). *The Manual of Learning Styles*. Maidenhead, Bershire: U.K.

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Roedel,T.D. , Schraw, G. , & Plake, B.S. (1994). Validation of a measure of learning and performance goal orientations. *Educational and Psychological Measurement*, 54 (4), 1013-1021.

Sheinhold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York: Bank Street College of Education, Center for Technology in Education.

Conflict Resolution in a Virtual Environment: Exploiting the Affordances of a Mulit-Object Oriented Environment

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Abstract: This paper describes the research and study concerning the concepts of conflict resolution and computer mediated communication. The purpose of this study was to assess the effectiveness of incorporating a text-based virtual world, a Multi-Object Oriented environment, with a conflict resolution curriculum centered around constructivist role-playing. Qualitative and quantitative results reveal positive answers to the research question. Future research is recommended on a broader scale, including longitudinal follow up assessments that include the sample's families.

1. Introduction

Research shows that most youth related violence is either directed at or perpetrated by one's friends or acquaintances (Bilchik, 1995; Lovett & Walzak, 1997; The problems of juvenile violence are multi-dimensional, involving the child, his/her family, friends, school, and community.

How can adults teach children to protect themselves in a proactive fashion? One possible answer is a skill set known as Conflict Resolution Management (CRM). Such tools as win-win outcomes, peer mediation, and emotional diffusement fall under the CRM heading (Johnson & Johnson, 1995). These skills enable children to stem violent conflicts, thus, transforming the emotional climate around their circle of contacts. One issue with conflict resolution training is the difficulty children often experience when discussing personal or painful issues (D'Andrea & Daniels, 1996;

Today, there are tools that make it possible to offer children a safe space within which they can explore the issues surrounding conflict. The anonymity of a virtual environment offers a sense of security that enables children to explore ideas and emotions that in a face-to-face environment would be to embarrassing or personal.

2. Background

2.1 Conflict and the Child

"Conflict is a natural human state often accompanying changes in our institutions or personal growth" (Ferrara, 1996, p. 29); unfortunately, this understanding is being lost on our children. Conflicts of insignificant relevancy, when considered against the broad spectrum of a child's life, are resulting in increasing numbers of violent episodes (Kelley, 1997). In and of itself, conflict is neither negative nor positive, it is how one resolves a conflict that leads to positive or negative outcomes (Brunner, 1990; In 1995, the greatest jump in the percentage of children perpetrating violent actions came between the age groups of 10- to 12- year-olds and 13- to 14-year-olds (FBI, 1995, p. 240). The need to reach children before they become accustomed to relying on violent behavior to deal with conflict is critical. The sooner a child is understands that conflict can be managed constructively, the less the possibility of a violent reaction to a disagreement or misunderstanding (Johnson & Johnson, 1995, p. 16).

Creating an atmosphere that affords the attainment of conflict resolution skills, where a student feels safe from peer rejection, is complicated. This is where technology can play a powerful role; a virtual environment allows a student to explore aspects of the self that are not associated with his/her in-class persona. Specifically, a Multi-Object Oriented environment (MOO) provides a virtual world that supports this type of learning.

2.2 A Multi-Object Oriented Environment

A MOO is a software program that accepts connections from multiple users and provides access to a shared database of "rooms" and other objects. It is a virtual reality, an electronically represented place (Curtis & Nichols, 1993). Within this world, participants are known as players. Players can not visually see each other; the entire world is text, so anonymity and a feeling of physical and emotional safety is preserved. It is thus that this study proposed to harness the potential of a MOO to create a learning experience that would positively impact student behaviors regarding conflict in the classroom. As a MOO was the focal environment, the project was named MOOsylvania. The name was designed to the appeal to preadolescents, and emit the essence of a far-off place. This helped establish the reality of the environment.

2.3 Constructivist Role-Playing

The primary tool used to acquire first-hand knowledge of conflict resolution concepts within the MOO was constructivist role-playing. A term coined by this researcher, constructivist role-playing has three separate, yet interrelated steps. First, in small groups, the children act out a given scene. Second, they discuss the scene; characters, actions, and choices are questioned and examined. The students decide on a desired outcome. Finally, the students replay the scene, experimenting with different actions and strategies related to CRM to experience how their choices affect others.

This offers an opportunity to discover how differing actions lead to differing outcomes. Through this type of role-playing, students have the opportunity to identify behavioral cues, expand their vocabulary regarding feelings, and work toward identifying nonverbal, emotional cues. Acting and experimenting with the use of verbal and nonverbal actions toward a positive resolution of a conflict allows a child to construct personal meaning and individual incentives for resolving conflicts positively.

2.4 Why an On Line Environment Is Better for Conflict Resolution Skill Attainment

As computers permeate adolescent life (Tapscott, 1998), it becomes logical that technology be used to support conflict resolution training (Carruthers et al., 1996). Technology offers the opportunity to (a) build personal knowledge through simulated experiences and (b) have one's thoughts visible so one can reread, rethink, and revise reactions to stimuli (Rosenberg, 1992). "Immersion in a simulated environment can provide an environment for working on important personal issues that feels less threatening than a face-to-face situation" (Turkle, 1995, pp. 188-189). Dede (1995) feels that immersion of the self in virtual worlds can enhance learners' understanding of phenomena in our shared reality because the experience is real, but is cushioned by the feeling of physical solitude.

Technology allows children to manipulate symbols and organize communication in more autonomous ways (Morrison & Collins, 1995). "For young adolescent students, with their increased cognitive abilities and developing sense of identity, a sense of autonomy may be particularly important" (Anderman & Midgley, 1998, p. 32).

This autonomy is supported by the anonymity of a MOO. There are no commands to discover the real-life identity of others. This privacy makes players' self-presentation crucial. Players can only be known by what they explicitly project and are not locked into any factors beyond their control, such as personal appearance (Curtis, 1992). The textual environment allows the creation of a distinctive self and the rehearsal of it (Young, 1994).

As well, this environment offers the opportunity to see one's words and actions before such things are visible to others. Communication in the computer-mediated MOO is synchronous but digitized. This gives the conversation a quality entirely different from the timing one experiences when chatting face-to-face. One cannot share a communiqué until they finish and hit the send button. Such an on-again off-again process has an impact on the communicative structure of virtual conversations, making it a more reflective experience (Marvin, 1995).

3. The Study

The intended population for this project is school children between the fifth and seventh grades. There were two groups involved in the creation/testing of MOOsylvania. The sample, the students whose behaviors were assessed, were called MOOers. The second group, older student volunteers, only met the MOOers on-line, and were identified as the Mentors. They facilitated the daily work and provided social role modeling.

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3.1 Research Question

This study attempted to answer one question that was designed to assess the power of an online environment as a setting for what Bruckman and others have termed identity work, i.e.: learning through experimentation with representations of the self (Bruckman, 1998; Turkle, 1995) in relation to conflict resolution.

Question 1
What is the impact of constructivist role-playing in a virtual environment on the manner in which a child uses language and deals with conflict within the real environment of the classroom?

3.2 Assessment

MOOers completed a pre and post questionnaire, the Coping Responses Inventory (CRI) Youth Form. The CRI-Youth Form can "help to describe an adolescent's coping responses to a specific stressful life circumstance" (Moos, 1993, p. 5), such as conflict. It is an appropriate tool for measuring changes in how a youth chooses to deal with conflict. Classroom behaviors related to student conflicts were observed. Interviews were conducted with students and teachers. This study generated both qualitative and quantitative data.

Research question	(Quantitative) CRI Youth Form	(Qualitative) Observations	(Qualitative) Interviews with teacher & assistant	(Qualitative) Focus group
1	X	X	X	X

Table 1. The research question and assessment data. CRI-Youth Form = Coping Responses Inventory – youth form.

3.3 Procedure

The "Safe Schools, Safe Students" report on successful anti-violence programs states that students should receive a minimum of ten 30-minute sessions (Cohen & Verber, 1998; Drug Stategies Weekly, 1998). With this in mind, the MOOers received twelve 45- minute MOOsylvania sessions.

4. Results

4.1 Sample

Twenty-nine children from Los Angeles, California participated in MOOsylvania (see Table 2).

	Group A	Group B	Total Sample
Gender			
Male	5	8	13
Female	9	7	16
Age (years)			
12	7	7	14
13	7	7	14
14	0	1	1
Grade			
6	7	8	15
7	7	7	14
Ethnicity			
African American	6	5	11
Latino	8	10	18

Table 2. Demographics of the sample.

4.2 Quantitative Data

While individually the results of the CRI components revealed no statistical significance from pre to post testing, it was clear that each subscale had moved in a positive direction with the hypothesis. A trend analysis method was used to determine the extent to which this trend was likely to be significant. For the six categories related to research question 1, the scores on all six changed in a fashion consistent with the research hypothesis. The probability of such consistency is $p < .002$, (1/26 = 1/64) where six out of six results changed in the hypothesized direction (see Figure 1).

CRI-Youth Inventory Category	Actual pre-testing average	Actual post-testing average	Direction of change of averages (pre to post)
Logical Analysis (LA)	8.793	9.655	Positive, agrees with hypothesis
Positive Reappraisal (PR)	7.103	8.689	Positive, agrees with hypothesis
Problem Solving (PS)	8.965	9.172	Positive, agrees with hypothesis
Cognitive Avoidance (CA)	8.143	8.137	Negative, agrees with hypothesis
Acceptance or Resignation (AR)	7.482	7.260	Positive, agrees with hypothesis
Seeking Alternative Rewards (SR)	8.172	8.344	Positive, agrees with hypothesis

Figure 1. Changes in pre and post testing of CRI-Youth Form, actual version, and the relation to the research hypothesis

4.3 Qualitative Data

4.3.1 Observations

Pre and post program observational data were collected in exactly the same fashion. Both sets of observations were conducted over two consecutive days for fours hours a day, making a total of eight hours of observations before and another eight after the program.

4.3.2 Pre Program

Of the 20 classroom incidents noted by the observers (see Figure 5), only 3 ended in a win-win situation. Four noted conflict situations ended in a lose-lose outcome, and the remaining 13 incidents were noted as a lose-win situation outcome. Several of these incidents were resolved only through teacher intervention.

4.3.3 Post Program

Sixteen classroom incidents were noted in the post program observations. All 16 were noted as ending in win-win outcomes and were resolved without any teacher intervention. In particular the observers were struck by the change in the way the students communicated with each other. The observers noticed the students reacting less emotionally to each other and expressing their feelings as opposed to the earlier observed behaviors of emotional reactions to words or perceived disrespectful behaviors by striking back with name calling or angry slang.

4.4.4 Significance of Observations

The observational data demonstrates positive changes in how the students related to each other in the classroom after participation in MOOsylvania. The number of lose-lose outcomes dropped from four to zero; win-lose dropped from 13 to zero. Win-win outcomes improved from 15% of observed incidents to 100% (see Figure 5).

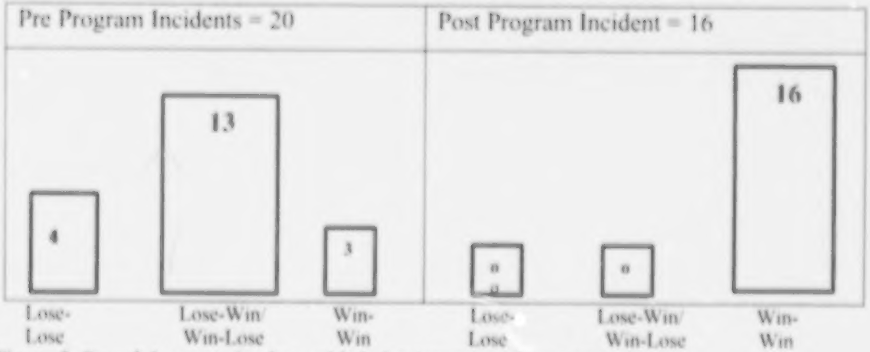

Figure 5. Sample's scores in observable behaviors pre and post program.

Situations that resulted in verbal altercations or negative emotions before MOOsylvania, were treated as minor moments or opportunities for self-expression after the program. The observers noted in their second observations that the students appeared to think and reflect before reacting; pre-program observations noted students using language to push people away, " you mind yourself boy", "you better back off". Post program observations noted less instances of such use, finding languagebeing used for inclusion, "we could do it like this", "we have to talk about it", "we can share". These data are consistent with the hypothesis that participation in MOOsylvania would afford a positive change in how the sample would deal with conflict in the classroom.

4.4.5 Teacher and Classroom Assistant Interviews

When questioned about changes in classroom behaviors, the teacher said things "seem a little better." The teacher was pleased that all 29 students were all able to abide by the guidelines of conduct and complete the program, and that alone should prove that the program "does help students with conflict on some level."

The classroom assistant offered several changes in behaviors and attitudes that he believed were direct results of MOOsylvania. One specific behavior relates to research question 1: an observed increased use of words to diffuse conflict. "Some kids, especially the girls, have gotten much better about explaining why they want someone to stop bugging them. Instead of just getting mad, they are using words, explaining why whatever the other kid is doing is bugging them."

4.4.6 Student Interviews

Twenty-seven students were interviewed; 17 of the students reported actually using the CRM skills (see Figure 8). Nine students reported using the skills at school. "I liked having something to say when stuff got hard with my friends"; "it was better to know what to do when a fight was gonna begin so I could stop it before we all got into trouble". When asked what they had used, one student said she tried to end a fight in a "win-win way so me and my friends would all be happy." Another reported listening and expressing feelings so that she could "keep communicating without getting into a big argument." When asked whether they thought they would continue to use these skills, each of the 17 who had tried the skills or strategies replied in a fashion similar to one girl. She said it was "good that I learned how to respect people more because now they respect me back more too."

Number of students in focus group	Used conflict resolution skills (anywhere)	Used conflict resolution in classroom	Used mediation in classroom	Used trying to find a win-win outcome in classroom	Used explaining their feelings in classroom	Used problem solving skills in classroom
27	17	9	4	2	1	2

Figure 6. Focus group comments on use of conflict resolution skills in classroom, post program

4.4.7. Unanticipated Student Benefits Inside the Classroom

The teacher credited MOOsylvania with teaching his students to work independently. He believed that it was the motivation to work at their own computer and participate in conversations that gave them the experience of working alone, and that experience transferred into the classroom. The classroom assistant echoed this idea with comments on improvement in the students writing skills. He also noticed an increase in student self-esteem and an increase in the class's enthusiasm for school. Several students mentioned improvements in the spelling and typing. As well, an increase in overall computer skills was mentioned in four of the post program interviews.

5. Conclusions

The combined findings from the CRI-Youth Form, interviews and observations all provide evidence that the MOOsylvania program, based upon constructivist role-playing in a text based, virtual environment, had a positive effect on how the students dealt with conflict in the classroom. The specific impact has been documented as a quantitative change in how the students chose to react to conflict, qualitative changes in observable behaviors and choice of language when dealing with conflict, and self-reporting of the use of conflict resolution skills and strategies in the classroom. The research behind the study supports the belief that it was the unique opportunity of exploring behaviors, actions, and different aspects of individual identity that afforded a learning experience that was powerful and meaningful enough to transfer from the realm of cyberspace into the reality of a child's everyday existence.

6. References

Anderman, L. H., & Midgley, C. (1998). Motivation and middle school students. Champaign, IL, Clearinghouse on Elementary and Early Childhood Education.

Bilchik, S. (1995). Reducing youth gun violence:An overview of programs and initiaves. Washington, DC: Office of Juvenile Justice and Delinquency Prevention. Available on-line: http://ncjrs.org/txtfiles/redyouth.txt.

Brunner, J. (1990). Acts of meaning. Cambridge, MA, Harvard University press.

Carruthers, W. L., Carruthers, B.J.B., Day-Vines, N.L., Bostick, D. and Watson, D.C. (1996). "Conflict resolution as curriculum: A definition, description, and process for integration in core curriculum." The School Counselor 43(5): 345-373.

Cohen, J. a. V., N. (1998). Publication review, Georiga Department of Education: Research and Policy Resource Center. 3.

D'Andrea, M. a. D., J. (1996). "Promoting peace in our schools:developmental, preventitive, and multicultural considerations." The School Counselor 44(1): 55-64.

Ferrara, J. (1996). Peer mediation: Finding a way to care. York, ME, Stenhouse Publishers.

Johnson, D. W. a. J., R.T. (1995). Reducing school violence through conflict resolution. Alexandra, Virginia, Association for Supervision and Curriculum Development.

Kelley, B. T., Huizinga, T.P. et all (1997). Epidemiology of serious violence. Juvenile Justice Bulletin. Washington, D.C., Office of Juvenile Justice and Delinquency Prevention: 11.

Marvin, L. E. (1995). "Spoof, spam, lurk and lag: The aesthetics of text-based virtual realities." The Journal of Computer Mediated Communication 1(2).

Moos, R. H. (1993). Coping responses inventory: Cri-youth form professional manual. Odessa, FL, Psychological Assessment Resources, Inc: 32.

Morrison, D. a. C., A. (1995). "Epistemic fluency and constructivist environments." Educational Technology 35(5): 39-45.

Rosenberg, M. S. (1992). Virtual reality: Reflections of life, dreams, and technology. An ethnography of a computer society. Cambridge, Massachusettes Institute of Technology.

Tapscott, D. (1998). Growing up digital. New York NY, McGraw-Hill.

Weekly, N. E. G. (1998). "Rating violence-prevention program: Guide for schools." National Education Goals Weekly 1(47).

Young, J. R. (1994). Textuality in cyberspace. Available on-line: http://www.eff.org/pub/Net_culture/MOO_MUD_IRC/textuality_in_cyberspace.article.

Implementing a Large Scale, Web Based Distance Education Course

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Abstract: T171 *You, your computer and the Net* is a large-scale distance education course produced at the Open University in the UK. It offers an introduction to computers and the Internet, and is aimed at a wide audience. The course is tutored entirely online and is delivered via the World Wide Web. This paper outlines the strategy for implementing such a course and the related pedagogical issues. These issues included developing appropriate student's skills, maintaining quality control, facilitating easy updating of material, ensuring student interaction with the material and making the material accessible and meaningful to a broad range of students. The manner in which each of these issues has been addressed is outlined. The course structure is a modular one based around accessible set texts, with wrap around academic material on the course web site. The course was piloted in 1999 with 900 students and demand for the course has been very high.

Introduction

Use of the Internet and the web in particular for distance education has been on the increase, with the rise of third generation courses [Nipper 1989]. The use of the Internet as the delivery mechanism for distance education offers a number of advantages over conventional methods, including quicker production and alteration of material, increased opportunity for feedback and interaction with students and flexibility in study patterns.

It has a number of limitations also, which mean it is not suitable for all types of material, or teaching methodologies. It is poor in comparison with most conventional methods of delivery when issues of access and cost are considered. The types of suitable media are also limited, for instance restrictions on bandwidth mean that delivery of video is still largely unrealistic for any meaningful educational purposes.

It has been suggested [Bates 1995] that there is a tendency with new technologies to add new technologies onto an existing model. This negates any advantages offered by an Internet based delivery method, whilst increasing the cost of the course production. The use of web delivery has met with mixed success. For instance, [Ward and Newlands 1998] report that students exercised a greater choice over study time, and had less time and financial expenditure with web based material compared to conventional lectures. However, they did not utilise the web fully, and often resorted to simply printing out the materials. It has also been reported [Warren and Rada 1998] that in order to duplicate the productive interchanges found in face to face sessions it was necessary to impose certain practices on computer conferences, including stringent deadlines for participation.

T171 *You, Your Computer and the Net* is an ICT foundation course developed at the Open University in the UK (OU). Its aim is to take computer beginners, and provide them with the skills needed to function productively with a personal computer and the Internet. It also aims to provide knowledge to place these technologies in context, so that by the end of the course students are comfortable both with using them and conversing about them and their wider implications.

Production of ICT courses has traditionally posed something of a problem for distance learning establishments, in that it is a rapidly changing field. A traditional print based OU course typically takes three to four years to produce and will be in presentation for eight years. This means the course material needs to have a shelf life of up to twelve years (although partial rewrites are often undertaken to modernise material part way through a course). The traditional print based production has meant that the OU has concentrated on getting its material as close to perfect on first presentation as is possible. The feedback from students combined with the production methods means that changes to course material can take some time to put into effect.

Given the factors outlined above, there were several aims for T171, which can be summarised as:

1. To produce a large scale, broad appeal ICT course.
2. To design a working method which allows for rapid production and alteration
3. To utilise an effective teaching methodology which would maximise the advantages the Internet offers as a delivery mechanism.
4. To teach both traditional study skills and those required to work effectively with the new technology.

In order to achieve these aims we were therefore faced with a number of issues which had to be addressed:

1. How to ensure that students develop new skills of working with this technology, for example avoiding the 'Print it all out' strategy described above.
2. To develop material which matches the OU's usual high standards but in a shortened time scale
3. To ensure that material can be updated or replaced easily without extensive course rewrites.
4. To ensure that students engage with material effectively, when they are unfamiliar with the topic.
5. To make material accessible to a wide range of students with different backgrounds and different needs.

The manner in which these five main issues were addressed in the course will be detailed separately.

Developing new skills

One method of ensuring students develop skills is to integrate them within the assessment of the course. T171 requires students to produce their assignments as HTML documents, and their working notes are also in this format, thus enforcing a familiarity with HTML and issues of web design. Students were required to formulate their notes so that they developed into a study journal over the course. They were directed by exercises at various stages to develop this journal. For instance, one activity requires them to reformulate their journal, producing a new index page according to categories of their own devising. This notion of organising material in different ways and use of hypertext as a means of thinking about and working with material is a skill the course team believes will be of value as the information content students are required to deal with continues to grow.

Assessment in T171 is ostensibly web based, in that students are required to develop a small web site for their end of course assessment, as well as 'web-essays' for their continuous assessment component. This is assessed not only on its content, but also its structure, design, use of the Internet as a resource and so forth. In this manner the importance of producing material for this new medium is reinforced.

By using interactive material, such as simulations of a modem connecting to a remote computer or microprocessor operation and interactive questions additional benefit is placed within the material. This provides an educational motive to engage with the material in its presented form, rather than reverting to prior study patterns, such as printing large quantities of the content.

The course team realised that students often need to work away from their computers. Two independently published set texts were therefore used in the course [Cringely 1996] & [Hafner & Lyon 1998]), which tell the basic story of the development of the personal computer and the Internet respectively

There was a strong emphasis on collaborative work via CMC in the course. Students were therefore required to engage in communication with other students and to co-ordinate their efforts. This was one aspect of the emphasis on computer conferencing in the course, which has no face to face tuition.

Producing high quality material in a short timescale

In order to produce teaching material in a shorter timescale than has been previously possible a number of decisions were taken. The first was to make the web the central method of delivery for course materials. This allows for a quicker production cycle than is usual with printed course texts . A second major decision was to create a modular structure. T171 consisted of three modules, with one academic author assigned per module, with the other authors and course team performing the task of critical review. The modules were largely independent of each other, thus allowing parallel production. The modules forming T171 can be summarised as follows:

- Becoming a confident computer user – an introduction to basic computer skills and applications, using the Internet and group working. The material was taught in a generic manner, so it was not software package specific.

- The story of the personal computer – using the set text, *Accidental Empires*, [Cringely 1996] to tell the basic story of the development of the computer, the module explores technological, social and economic issues raised by the material.

- The story of the Internet – using the set text, *Where Wizards Stay Up Late*, [Hafner and Lyon 1998] again to tell the basic story of the development of the Internet, the web site material explores issues such as the development of protocols, paradigm shifts and social impact of the Internet.

Another important feature of the production model was the use of set texts. These formed the function of telling the 'basic story' of modules two and three. Both books were very readable accounts of their respective stories, and not traditional academic texts. The web site represents the academic content, which wraps around the set texts.

The production of material was a more iterative process than in standard production, with less clearly defined roles. The use of design templates means the author can quickly produce material which is close to the finished article, although it still requires editing, reviewing and some fine-tuning of design.

Easy updating

The use of web based material over print means material can be updated much easier and at considerably less cost. This is particularly relevant in a rapidly changing field. By making the course web based the course team could make use of external web sites which maintain up to date material on issues which are developing during the course.

The modular approach offers the advantage of easy updating as well as quick production. The modules were independent to a degree, which means material in any module can be easily altered without inducing large changes throughout the course. This independence of modules was not absolute, as there was some integration to allow for the development of study skills through the courses.

Engage with material

Module one in particular was structured around an activity based learning model. For example using the web was formulated as a scenario where a group of four students were required to create a web site for a fictional client. This formed part of the assessment for module one, so students were required to partake in the activity. A portfolio of evidence formed part of the end of course assessment, so students were required to produce evidence of conferencing, note taking, summarising and so on. In this manner the assessment reinforces various methods by which students can engage with the material, and with each other.

This emphasis on conferencing and group learning places learning as a social function [Bates 1995]. It is therefore important to introduce students to the use of CMC, and to increase their communication skills. This was done through exercises in module one, gradually developing the student's communication skills. The material in modules two and three could therefore rely on these skills being in place, and utilise discussion as a learning method.

Throughout the course 'study guides' are delivered fortnightly as an e-mail attachment. In modules two and three the students adapt these to create their own study journal on their hard disks. There are also a number of tutor group activities which allow students to share information, and to compare study approaches. As has been mentioned the assessment model reinforces the importance of this approach.

Accessibility

T171 was aimed at a broad audience, not just technology or computer science students. One key aspect in achieving this accessibility was the use of the readable set texts mentioned above. This approach uses a narrative based method as a means of exploring the issues raised by the material. The importance of narrative as an educational methodology is emphasised by the use of multi-media, where many students feel 'lost' without a conventional narrative structure to guide them through [Laurillard 1998]. The narrative led teaching methodology also places an emphasis on demythologising the subject, by placing it within a context. It also allows the material to naturally cover a broad spectrum of issues, including the technology (for example the architecture of a computer), the social impact of computers and the Internet (for example the implications of the 'Information society'), the industry (for example the role of Microsoft) and so on.

There was some preparatory material, to familiarise students with the basic operation of a computer, and the Windows operating system. There were a number of other exercises including a web browser tutorial and a keyboard tutor. This allows students with a broad range of experience to study the course.

Once again the use of conferencing aids the realisation of this aim. Within the material there are a number of 'embedded conferences' that focus on a seeded discussion relating to the material students have just read.

Course presentation

The course has the overall structure of three modules, with a web site adding academic wrap around material to readable set texts. The course lasts for 32 weeks, with four tutor marked assignments (TMAs) and one end of course assessment. Students are guided through the material by regular study guides which are delivered as e-mail attachments. Tuition is conducted online and a number of group activities are embedded within the material.

A pilot study of the course was presented in 1999, with over 900 students. Demand for the course was considerable, and estimates for student numbers in 2000 are in excess of 5,000. The demographics of the current cohort of students show that the course is divided fairly evenly according to gender (approximately 44% female), there is a broad age range from 18 years old to 82, a large proportion of students are new to the OU, and many of them are principally taking non-technological degree profiles. Evaluation of the course is being undertaken.

Conclusions

We can now review the original aims of the course, and see to what extent these have been satisfied by the model outlined above. The first of the aims was to produce a large scale, broad appeal course. The student demand for the course, and the diversity of the student cohort seems to indicate that, at this stage at least, this has been achieved. The second aim was to devise a working method to allow for quick production and alteration of material. The course was produced in a year, which represents a considerable improvement on most OU course production cycles. Much of the time was spent in devising the working model, and setting up a suitable technical structure for the course. Much of this is a one-off investment, and future courses which adopted a similar model could improve upon this time frame even further. There are a number of such modules now in development in diverse topics. The third aim was utilise the Internet as a delivery mechanism by adopting a suitable teaching strategy. The use of the web material plus set text, in addition to the emphasis on conferencing and group work suits the material, and offers the advantages of the Internet outlined at the start of this paper. Whether it is an effective learning mechanism for students can only be known in detail when full evaluation of the course has occurred. The last aim was to teach both traditional and new study skills. The use of exercises, group work and the assessment strategy has been the means by which this has been implemented. Again early feedback is positive, but firm conclusions must await the outcome of the evaluation.

In conclusion the model developed by T171 seems to support large-scale web based distance education courses, which are distinct from 'campus' models.

References

[Nipper 1989] Nipper, S. (1989) Third generation distance learning and computer conferencing. *in* Mason, R. and Kaye, A. *Mindweave: Communication, Computers and Distance Education*, Oxford: Pergamon.

[Bates 1995] Bates, A.W. (1995) *Technology, Open Learning and Distance Education*. London: Routledge.

[Ward and Newlands 1998] Ward, M. & Newlands D. (1998) Use of the Web in undergraduate teaching". *Computers and education*, **31**. pp 171-184.

[Warren and Rada 1998] Warren, K.J. & Rada, R. (1998) Sustaining computer-mediated communication in university courses. *Journal of Computer Assisted Learning*, **14**. pp 71-80.

[Cringely 1996] Cringely, R.X. (1996) *Accidental Empires*. Penguin, London.

[Hafner and Lyon 1998] Hafner, K. & Lyon, M. (1998) *Where Wizards Stay Up Late: The Origins of the Internet*. Simon & Schuster, New York.

[Laurillard 1998] Laurillard, D. "Multimedia and the learner's experience of narrative" *Computers and Education*, **31**. pp 229-242.

The Design and Development of an Evaluation System for Online Instruction

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Abstract: With the growth in popularity of online instruction has also come the concern for accountability and the need to make adjustments and improvements in online programs. This paper describes the conceptualization and development of an evaluation system that can be used to monitor and evaluate online instructional efforts. The evaluation system addresses concerns of both program administrators and course instructors. Computer technology is used to provide partial automation to reduce respondent burden and to efficiently use evaluation resources.

1. Introduction

Online or web-based learning is an education and training phenomena that is growing rapidly around the globe. As with any innovation, there are questions about effectiveness, efficiency, and utility (McCollum, 1998). With online instruction, the issue of evaluation and accreditation is especially important due to various threats commonly perceived by educators and trainers. These threats include a change in student campus life and the roles of professors (McCollum, 1998), the fear that the push for distance learning comes from entrepreneurs and university "bean counters" rather than educators (Mendels, 1999), and whether virtual students feel more isolated than their traditional counterparts (Arenson, 1998). These concerns can only be addressed through systematic research and evaluation efforts.

Human resource development professionals (educators that are typically situated in nonschool settings) are blessed with a rich history of evaluation thought, development, and research, primarily derived from the fields of education (Patton, 1997; Scriven, 1967; Stake, 1981; Stufflebeam & Shinkfield, 1985; Stufflebeam, Foley, Gaphart, Guba, Hammond, Merriman, & Provus, 1971) and human resource development (Holton, 1995; Kirkpatrick, 1976; 1996; 1998; Kaufman & Keller, 1994). From these foundations, specialized evaluation processes and systems have been designed and implemented for HRD interventions, including training programs (Raab, Swanson, Wentling, & Clark, 1992, Wentling, 1980, 1993).

The design of evaluation systems for online instruction has been attempted by a number of professionals, including instructional designers of CBT systems (Clark, 1994; Draper, 1996; Simonson, 1997) technology experts (Jackson, 1990; Kimball, 1998; Middleton, 1997), and HRD practitioners (Magalhaes & Schiel, 1997; Pisik, 1997). The work of these individuals demonstrates progress in applying intuitive principles and practices of evaluation to online environments. Other authors have provided practical applications of evaluation theory by offering suggestions and guidelines for the evaluation of online instruction (Khan, 1997; Nichols, 1997; Oakes, 1997; Ravitz, 1997; Thorpe, 1993).

The evaluation of online instruction is an important part of the design and implementation process. Even though practitioners and academics currently evaluate online instruction, their attempts have been limited to the use of traditional research methods and intuitive approaches to evaluation. Additionally, much of the inquiry focused on web-based learning is done as research studies with limited scope and of highly situational utility. There appears to be a lack of systematic evaluation of online programs built on evaluation theory and practice. The activity described in this paper is an attempt to conceptualize and develop a transferable, adaptive evaluation system for online instruction.

2. Conceptualization and Development of the Evaluation System

The purpose of this project was to design, develop, and implement an evaluation system that would meet the needs of the developers and sponsors of online instructional programs. The activities of the project reflect major efforts to obtain information, design components of the evaluation system, and test and revise the evaluation system. The specific activities were to (1) develop a conceptual model for online evaluation, (2) identify specific vital signs for an online program and determine appropriate measures, (3) automate the collection and analysis of evaluation data using knowledge engineering, (4) create an electronic performance support system to assist in program evaluation, and (5) conduct a field test of the evaluation system. The following sections describe each of the five major activities being accomplished in the formulation of the Illinois Online Evaluation System. At the time of this writing the evaluation system is evolving. Many of the tasks are complete, while some are underway.

2.1 Activity 1: Development of a Conceptual Model for Online Evaluation

This activity involved the conceptualization and design of the overall evaluation system, with the identification of major components and their functional relationships. The evaluation system, as currently designed, occurs in three stages: (1) vital sign assessment, (2) in-depth analysis, and (3) program improvement planning (see Figure 1). The evaluation system can best be explained using a medical analogy in which a physician examines a patient's vital signs to determine the patient's current state of health. Vital signs that are below acceptable standards are examined in more detail, utilizing more precise information and investigative techniques. As a result of the analysis, a plan is developed to facilitate improvement.

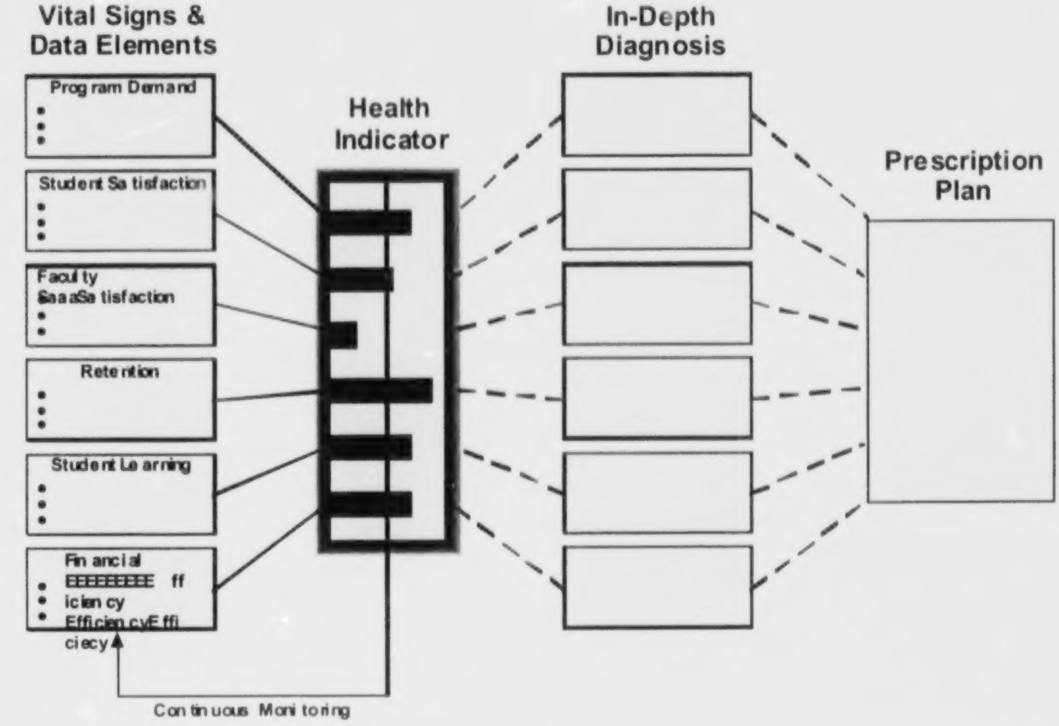

Figure 1. The Online Evaluation System.

Vital sign assessment (Stage 1) diagnoses the general health of the online program and individual online courses using data collected through routine activities. Example data include the number of inquiries about the program, the number of applications received, and the performance of students in the individual courses. The data are used to calculate a program's "health" rating in six areas: (1) student demand, (2) student retention, (3) student satisfaction, (4) faculty satisfaction, (5) student achievement, and (6) financial efficiency. The ratings help program personnel and sponsors monitor the overall performance of the program and individual courses to identify areas that may be problematic.

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During the *in-depth analysis* (Stage 2), any vital signs that are identified as substandard are analyzed in detail. A thorough investigation is conducted to determine underlying problems or causes. Often this investigation requires the collection of additional data, or the use of data from related vital signs. For example, a low rating in student satisfaction might lead to the further analysis of the individual items that comprise the student rating indicator. Additionally, a review of data related to student learning and faculty satisfaction might be done.

Program improvement planning (Stage 3) provides solutions to the problems that are investigated during the in-depth analysis. Alternative strategies for solving the problems are identified, along with resource requirements for implementing the solutions. Program personnel are able to select various courses of action and develop plans for addressing the identified problems.

2.2 Activity 2: Vital Sign Identification and Development of Instruments and Procedures

The major activity in the development of the evaluation system involved several inquiry endeavors to identify "quality indicators" for use as assessment criteria. Lists of quality indicators drawn from the literature on computer-mediated education, outcomes of education, and evaluation were identified and prioritized. An initial list of 18 "vital signs," developed from the results of the literature was reviewed by a group consisting of HRD and evaluation experts. The list of vital signs was reduced to six by determining the relative importance of each to the stakeholders of the evaluation.

Instruments and procedures for gathering, summarizing, and analyzing vital sign data have been developed by project staff. Data used to calculate vital sign ratings are obtained through analysis of electronic archives, document review, surveys, student testing, and expert review. Sample data elements used to calculate each vital sign rating are described in Table 1. The actual vital sign ratings are calculated from student test scores, mean scores on survey instruments (i.e., student satisfaction and faculty satisfaction), and data comparisons (e.g., enrollment, retention, financial data). Standard transformations of the data are performed to provide a common scale for each vital sign to facilitate portrayal and comparison across the vital signs.

Vital Signs	***Data Elements***
Program Demand	• Number of applications requested per semester • Number of applications received per semester • Number of telephone contacts per semester
Student Satisfaction	• End of course student ratings of program content, quality of instruction, instructional resources, technology used, amount of interaction, instructional methods • Mid-semester student ratings • CISS data regarding perceptions of course interaction, course structure, and technical support
Faculty Satisfaction	• Faculty ratings of technology, technical support, interaction with students, quality of student work
Student Retention	• Percentage of dropouts from beginning to end of each course and the program
Student Learning	• Self-assessment of learning and transfer • Course project scores • Quiz and Test scores • Course grades
Financial Efficiency	• Total unit cost, direct cost, overhead cost, • Tuition revenue

Table 1: Data Elements for Vital Sign Rating Calculation.

2.3 Activity 3: Knowledge Engineering

As work progressed in conceptualizing the evaluation system and identifying vital signs, alternatives for automating the system were explored. Literature on artificial intelligence, decision support software, electronic performance support systems (EPSS), and expert systems was reviewed by project staff. Due to the technology potential for the evaluation model, its focus on internal rather than external evaluation, and its purpose as a self-evaluation tool to be used by a variety of online personnel, including program administrators, instructors, and instructional designers, it was ultimately decided to utilize performance improvement technologies to automate much of the data collection and analysis functions. Performance improvement technologies make dynamic use of technology to facilitate data collection and analysis tasks and to improve individual performance by providing timely information, advice, coaching, and training. An electronic performance support system is an example of a performance improvement technology that "captures, stores, and distributes individual and corporate knowledge assets throughout an organization to enable an individual to achieve a required level of performance in the fastest possible time and with the minimum of support from other people" (Raybould, 1995, p. 11). EPSS technologies often include an information database, an expert advisor, customized tools and templates, and the potential to run simulations. Beyond a few efforts in corporate settings, this technology has not been widely applied in education and training for evaluation purposes.

Available literature on performance improvement technologies was reviewed. A key component to any expert system is the knowledge base of a recognized expert in the problem area (Hayes-Roth, Waterman, & Lenat, 1983). Focus groups of recognized online education experts from the University of Illinois were held to ascertain their perceptions of what constitutes effective online education and evaluation. These experts worked through simulated evaluation problems to test their ideas and were asked to develop specific guidelines and suggestions for improving the vital sign assessment and in-depth procedures. The framework for the expert system was based on the outcomes of this activity.

2.4 Activity 4: EPSS Development

The investigative framework gleaned from the knowledge engineering activity was developed into a series of If-Then rule process charts (one for each vital sign) by the developers. One partial example of a vital sign rule process chart is shown in Table 2 where a variety of "then" statements are provided in response to the low indication of student satisfaction.

Vital Signs	*Data Elements*
IF: • Student Satisfaction as indicated by Student Rating Form is Low,	THEN: • review subscores for student ratings results. • identify the subscores that reveal the area of problem. • review results to individual items in the problem subscore(s).
IF: • If more information is needed to determine the problem,	THEN: • develop an interview questionnaire and contact a sample of students by phone. • develop an e-mail questionnaire with relevant questions and send to a sample of students. • summarize new student data. • present the summary of all results to the instructor and discuss potential causes of the problem.

Table 2: Sample EPSS Rule Process Chart for One Vital Sign.

The probable causes identified by the online instruction stakeholders were incorporated into the rule process charts to complete the exploration diagrams. Sample computer display screens were also developed that simulate what each screen on the finished performance system program should look like. Using the rule process charts and sample screens, project staff created the performance support system. Prototype system routines were reviewed and revised to correct programming errors, to improve interface inadequacies, and to ensure user friendliness.

2.5 Activity 5: Field Testing

The performance support system shell was reviewed by selected professionals as a preliminary step to pilot testing. Data were programmed into the system to allow users to explore all possible investigative paths in the in-depth analysis. Formal and informal feedback was provided, which resulted in minor revisions in the programming (elimination of "bugs" from the system) and content of the evaluation system. The evaluation system is currently being tested within an online masters degree program in HRD at a large U.S. university. Following this initial testing, there are plans to expand the field testing to other university level online programs and in corporate settings.

3. Implications and Discussion

What truly separates the vital sign concept from traditional evaluation is its use of specific outcome measures with minimal data requirements to create a cursory picture of the general status of a program. The six vital signs are measured for each individual online course. Efficiency is maximized because initial data requirements are minimal, only specific programs are examined, and only problematic vital signs are subjected to further examination.

The most obvious technical feature of this new evaluation system is its use of the electronic performance support system. Used primarily in medicine, manufacturing, and engineering up to this point, this is one of the first attempts to adapt advanced technology to educational evaluation. This application, of course, has its limitations. Attempting to set limits on variables in social science research always causes consternation, for fear of eliminating some possible responses from consideration. In developing investigative paths for the expert system, limits had to be set. However, the data collection instruments and procedures were carefully developed and extensively field tested. The knowledge and skill of recognized evaluation and online experts were incorporated into the system. These factors, coupled with the extensive field testing still to be completed, result in an evaluation system that is as true to human expert evaluation as possible. It is also important that the system will be operated by human evaluators and all final judgments will be made by personnel of the program online. Thus, it should not be construed that the computer is replacing the human evaluator. It is only providing valuable assistance, which will facilitate self-evaluation of online programs.

The broad applicability of the vital signs gives this system utility for online program evaluation beyond the University of Illinois. Ultimately, the model developed for use in this system, along with the computer technologies that are applied, could be adapted for use in evaluating any online course or program in the public sector as well as in private sector training and human resource development programs.

4. References

Arenson, K. W. (1998, November 2). More colleges plunging into uncharted waters of online courses. *The New York Times.*

Clark, R. E. (1994). Assessment of distance learning technology. In E. L. Baker & H. F. O'Neil, Jr. (Eds.), *Technology assessment in education and training* (pp. 63-78). Hillsdale, NJ: Erlbaum.

Draper, S. W. (1996). Observing, measuring, or evaluating courseware [On-line]. Available: http://www.psy.gla.ac.uk/~steve/Eval.HE.html

Hayes-Roth, F., Waterman, D., & Lenat, D. (1983) *Building expert systems.* Reading, MA: Addison-Wesley.

Holton, E. F. III. (1995). In search of an integrated model for HRD evaluation. In E. F. III, Holton (Ed.), *Proceedings of the 1995 Academy of Human Resource Development Annual Conference* (pp. 4-2). Baton Rouge, LA: Academy of HRD.

Jackson, G. A. (1990). Evaluating learning technology: Methods, strategies, and examples in higher education. *Journal of Higher Education, 61*(3), 294-311.

Kaufman, R., & Keller, J. M. (1994). Levels of evaluation: Beyond Kirkpatrick. *Human Resource Development Quarterly, 5*, 371-380.

Khan, B. H. (1997). Factors to consider when evaluating a web-based instruction course: A survey. In B. H. Khan (Ed.), *Web-based instruction* (pp. 375-378). Englewood Cliffs, NJ: Educational Technology Publications.

Kimball, L. (1998). Easier evaluation with web-based tools. *Training & Development, 52*(4), 54-55.

Kirkpatrick, D. L. (1976). Evaluation of training. In R. L. Craig (Ed.), *Training and development handbook* (pp. 18-1-18-27). New York: McGraw-Hill.

Kirkpatrick, D. L. (1996). Evaluation. In R. L. Craig (Ed)., *Training and development handbook* (4th ed., pp. 294-312). New York: McGraw-Hill.

Kirkpatrick, D. L. (1998). *Evaluating training programs* (2nd ed.). San Francisco: Berrrett-Koehler.

Magalhaes, M. G. M., & Schiel, D. (1997). A method for evaluation of a course delivered via the world wide web in Brazil. *The American Journal of Distance Education, 11*(2), 64-71.

McCollum, K. (1998, May 15). Accreditors are urged to prepare to evaluate distance learning. *The Chronicle of Higher Education*, A34.

Mendels, P. (1999, January 6). Universities embrace technology, but distance learning faces controversy. *The New York Times*, Education Column.

Middleton, A. J. (1997). How effective is distance education?. *International Journal of Instructional Media, 24*(2), 133-137.

Nichols, G. W. (1997). Formative evaluation of web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 369-374). Englewood Cliffs, NJ: Educational Technology Publications.

Oakes, K. (1997). The hardest question to answer about CBT. *Training & Development, 51*(9), 45-47.

Patton, M. Q. (1997). *Utilization-focused evaluation: The new century text* (3rd ed.). Thousand Oaks, CA: SAGE.

Pisik, G. B. (1997). Is this course instructionally sound? A guide to evaluating online training courses. *Educational Technology, 37*(4), 50-59.

Raab, R., Swanson, B., Wentling, T. L., & Clark, C. (1992). *Training Evaluation*. Rome, Italy: Food and Agriculture Organization of the United Nations.

Ravitz, J. (1997). Evaluating learning networks: A special challenge for web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 361-368). Englewood Cliffs, NJ: Educational Technology Publications.

Raybould, B. (1995). Performance support engineering: An emerging development methodology for enabling organizational learning. *Performance Improvement Quarterly, 8*(1), 7-22.

Scriven, M. S. (1967). *The methodology of evaluation* (Perspectives of Curriculum Evaluation, and AERA monograph Series on Curriculum Evaluation, No. 1). Chicago: Rand NcNally.

Simonson, M. R. (1997). Evaluating teaching and learning at a distance. *New Directions for Teaching and Learning, 71*, 87-94.

Stake, R. E. (1981). Setting standards for educational evaluators. *Evaluation News, 2*(2), 148-152.

Stufflebeam, D. L., Foley, W. J., Gaphart, W. J., Guba, E. G., Hammond, R. L., Merriman, H. O., & Provus, M. M. (1971). *Educational evaluation and decision making*. Itasca, IL: Peacock.

Stufflebeam, D. L., & Shinkfield, A. J. (1985). *Systematic Evaluation*. Boston: Kluwer-Nijhoff.

Thorpe, M. (1993). *Evaluating open & distance learning* (2nd ed.). London: Longman.

Wentling, T. L. (1980). *Evaluating occupational education and training programs*. Urbana, IL: Griffon Press.

Wentling, T. L.(1993). *A trainer's guide to curriculum development*. Rome, Italy: Food and Agriculture Organization of the United Nations.

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The University of the Third Millennium

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Abstract: The authors, between them, have helped create ITCampus, a collection of resources for students and professors, and Clyde Virtual University (CVU), one of the first virtual universities. They have combined their forces during 1999 to build The University of the Third Millennium. This new work develops on the lessons learned with CVU and offers a new metaphor for next generation virtual universities. There are many difficult educational challenges associated with the future of online higher education. The Universities of Glasgow and Lund have joined forces in an attempt to tackle some of them.

In this paper we outline some fundamental ideas for our work during this year. We examine the economic forces, educational requirements and technical possibilities that will shape the next decade of university development. We suggest a new model for education that:

- the cost per student will decrease radically as the numbers of students increase,
- new features will increase the quality of education,
- new forms for assessment will be critical to success.

1. Economics

The Universities of Lund and Glasgow have both been around for hundreds of years. They have gone through many developments over the last few hundred years. Now a more dramatic change both in scale and speed is expected. Neither University can rely upon a local population who will opt to study locally. Neither Lund nor Glasgow or any other higher education institution can ignore the economic forces that will have profound influence over the next twenty years.

The economic pressures on both institutions and students will not abate. Institutions will be expected to educate more students at lower unit resource, they will also be expected to broaden their reach to include lifelong learners. They'll need to develop courses more suited, in both structure and content, to the needs of the employed. The economic pressures on students may have the greatest influence on how higher education evolves. In the future, students may have a stark choice to make: wait years before embarking on a career, in the mean time accruing significant debt or start work after leaving school and study for a degree in parallel with their developing career.

Seen from a global perspective there is a tremendous shortage of teachers on all levels. The traditional model for education is not scalable to the needs of the future when we must educate a larger fraction of the population. We can simply not afford it. Our current model is not affordable in the countries of Africa and Asia where the majority of the world's population is living. This creates a challenge for universities now fighting with financial problems and laying off professors as its income decreases. There could be a large market in exporting education.

Staff development will be all-important. Most faculty today are valued for what they know of their discipline. Maybe tomorrow they'll also be valued for what they can teach of the their discipline. They may then go on to teach it to the world. We have to start to think globally.

2. A Shift of Paradigm

During the 20th century we have seen some shifts of paradigm. An agricultural society became an industrialized society and then to today's knowledge society. These shifts have always been associated with threats and possibilities for the individual. Perhaps one of the keywords in the transitions is rationalization; producing more of better quality to a cheaper price. Looking at education we can see the same trends and the challenges of today is to:

- Educate many more students (most will be lifelong learners),
- with higher quality courses,
- which are more targeted to their individual needs,
- at a much lower cost.

In the next century the power and the decision over education will move from the producer, the teacher or university to the consumer. For example, this shift of power to the consumer has already happened to the car industry and news media. Newspapers today have to write what the readers want to read or they will not buy the papers and those papers will go out of business. Imagine a future where the universities have to give courses that the students want if they are to stay in business. Is this a development we would like?

One of the challenges for today's education systems is that they are not scalable in the sense of mass production. To double the number of students often means doubling the costs. This is not possible for most countries. This creates an exciting challenge to learn from cooperation, mass production and rationalization in other areas and find models for education, where the cost per student is decreasing as the number of students increases.

Let's think about a scenario parallel with the shoemaker (new role of the teacher). To get an idea of what the paradigm shift could mean to the teacher, we can look at the old time shoemaker. He produced individually hand-stitched shoes for the people close to him. When the first machine-made shoes arrived people said that they could not suite your foot and would be very uncomfortable. Today we all wear machine made shoes and think they usually fit well, they are much cheaper and we have many more shoes than our grandfathers ever did.

Today we talk about the impossibility of being taught by a machine and the importance of the teacher. The authors can see a future where we buy our tailor made education from future education factories. Let us compare this with the car industry. When you buy a car today you sometimes design your own car and it is manufactured for you. We also expect education to be better, cheaper and closer to our needs. The roll of the teacher could change either to education shop assistant (like the car showroom assistant) or to education designer in a big education factory (like the car designer).

3. Educational Requirements

Having discussed the economics that will make change inevitable, let us next consider the educational requirements of the online learner in the next millennium. In particular we need to address problems of assessment, community and courses.

3.1 New Ways of Assessment and New Ways to Study

Virtual universities need a new way of assessment as this is always the factor that most influences learning. Students often only focus on those aspects that are likely to appear in exams. To focus the student's learning on all aspects of a course we are challenged to develop new forms of assessment as success with assessment will change the way we learn [Bennet 1997].

In the future, employers will have applicants to choose from with degrees from all over the world. How should these degrees be compared? If employers really want to know what skills and knowledge any particular degree or diploma represents they will either rely upon documentary evidence or have to hire external expertise.

The Portfolio concept will therefore be of central importance. The student will have to be able to convince their future employer that they are the right person for the job. Online education, with term papers and assignments kept online, will give possibilities for the student to easily direct an employer to their work.

In many online courses today the assessment must be taken in the traditional form, this can be a requirement that makes it impossible for the student to successfully complete those courses. Assessment online is therefore a necessary ingredient in future online distance courses and we have to find forms for that.

To stimulate the discussion we will demonstrate an assessment of open-ended questions without the need of a human marker - a tool that could reduce costs and increase quality.

We would like to shift from assessment as a scary and intimidating experience to look at assessment as a learning tool. In this transition it is important to ask: What do we assess? What do employers ask for? Can the assessment be used as a tool to find a match between the students' and employers' needs? In a rapidly changing society we must answer these questions ourselves; what kind of assessment do we really need in the 3rd millennium?

Investigations [Kjöllerström 1974] have shown that traditional exams often only address the lower levels of cognitive skill in the Bloom's taxonomy [Bloom 1956]. We are trying to find forms of online examinations that address higher levels.

Exercises for teachers who want to prepare for education in the third millennium

Preparing students for working life
- Look at ads for jobs that your students could apply for. Find and list at least ten qualifications/skills that are required in several of the ads!
- For each of the qualifications/skills write down where and how you prepare the students!
- What could you do to help your students show and document that they have these qualifications/skills?

Preparing for exams of tomorrow
- On your next exam ask your students to bring and use their own telephone and computer.
- How will that change the questions?
- How will that change how students learn?

3.2 New Learning Communities

How will students studying an online course be helped to feel less isolated? How do we address the loneliness of the long distance learner?

Online courses will probably be most popular among adult learners who want: to learn more, to qualify for promotion, to be retrained for a new job or just have fun. One of the most difficult problems in distance education is that today only 20-30% of the starters manage to complete their studies. This could be due to: lack of fellow students to talk to, not interesting enough study material, too few sticks and carrots, personal change in circumstances.

We have to build the University of the Third Millennium to tackle all these problems. We need to develop and deploy sophisticated messaging systems that will allow the same very broad range of communication channels that exist in traditional face to face education. Using the same basic notice board system for announcements, questions about the course, group work and private discussion is probably not sufficient. Something new is needed.

3.3 Course Quality

Through diagnostic testing we can find out what the student really needs and provide a course suited to the needs of the individual. In the continuation of this we foresee tailor made individual courses on demand. Through the computer the students' activities will be monitored and students and teachers will get an early warning when someone lags behind.

The quality of the courses has to rise substantially. One way of achieving this is to ask teachers who today develop their own, but similar courses, to form teams and share the work differently. Each takes responsibility for a more narrow part and has thus more time to tie the course closer to modern research and pedagogical methods, borrowing ideas e.g. from TV. To increase quality in media production and still stay within present cost we suggest a redistribution of the teacher workload. Instead of having 20 teachers taking 3 hours to prepare a similar lecture they could spend 60 hours preparing different lectures that they share among themselves.

3.4 Skills for Life

To improve the quality of the degrees from the university of the third millennium, it will offer free courses in areas that are intensely asked for by employers in their ads for new personnel. Here we think of courses like:

- How to write a report
- How to communicate
- How to present on posters and overheads
- How to get on with the press
- How to give a talk
- Study skills
- Cooperation skills
- Managing cooperation
- Managing your time

These courses will contain interactive exercises to develop the skills, teacher support, online examination and credit will be awarded. In Europe there is already an initiative to encourage everyone to take a computer driving licence [ECDL 1999]. Perhaps this idea could be extended to provide other types of driving licences. They could cover communication skills, organizing your own work, teamwork, leadership etc.

4. Computers and Information Technology

Computers and information technology have already transformed many businesses and industries. Many businesses have closed and many have opened. Some people have lost jobs and some have found jobs. Most jobs have changed almost beyond recognition. We can expect their impact on higher education to be no less profound [Coopers & Lybrand 1998].

Satellite in low orbits will, in about three years, enable high bandwidth Internet access from everywhere on the globe. The computer will be small as a matchbox and cost much less than today. The screen will have a resolution 300 times better than today making it the preferred medium for the book. Speakers, microphone and video will be included on each screen making live communication with people all over the globe possible.

Globalization will cause current national rules to be abolished. Prerequisites will be largely meaningless. A global market economy will prevail. Some universities will become smaller, others will become larger. Some faculty will lose their jobs while others will do well. All our jobs will change dramatically.

The Australian Government's Department of Employment, Education, Training and Youth Affairs was cautious in their study [Cunningham 1998] of the impact of globalization on their domestic post-compulsory education sector. They identified a "Death Star Scenario" where global media organizations join forces with high tech companies and top-rated universities to deliver killer degrees and totally dominate lucrative disciplines. However they found little evidence of an immediate risk. There may have been "little evidence" in 1997 but the situation is changing rapidly.

In 2005 students (or however they'll be referred to by then) will enrol on courses as and when they want. Their virtual university will be a global university. It will include all the online offerings of every remaining university. Quality, accessibility and value for money will be key criteria when a student decides which courses to purchase.

The virtual university is a tremendous challenge!

Building good online courses will be tough but the elements of good courses are starting to appear. The development of sophisticated new question types [Whittington 1998] make it possible to build open ended questions that help students reflect on their grasp of the subject. Work on automated essay assessment [Chung & O'Neil 1997, Whittington and Hunt 1999] is looking promising and could have dramatic impact on how we assess within online courses.

Building systems that overcome the isolating effect of studying online will be much harder. Today's virtual university is typically a lonely place and effort has to be made to meet people. The metaphor for most virtual universities has been that of the campus with graphical representations for the various features: lecture theatre, lab, seminar room etc. Application of this metaphor usually involves different areas of the Web site providing different functions and we end up with communication tools only being available in certain areas. On a real campus people talk everywhere, they don't have to "go to the cafe" to join in a discussion.

A new metaphor might involve a student's desk. On the desk would be current work. There may be a calendar or timetable to one side with a list of the student's courses. From their desk the student can contact other students, messages can be left for friends, video links can be made at the touch of a button. The student's videophone, answering service, and address book are built into their desktop. Tools such as ICQ [ICQ 1999] suggest a way forward but these tools will have to be deeply embedded within the structure of the virtual university.

Our university of the third millennium will be built with some key unique features:

- Students (not the campus) will be in the center, in a learning community where student interaction is an important learning tool.
- Skills for life will be a free integral part of the diploma.
- All assessment is a learning experience and all learning is assessed.
- Online assessment will target higher levels of Bloom's taxonomy.
- Templates will help teachers cooperate in building modularized courses.
- Reuse of modules will allow us to produce tailor made education on demand.

5. Tools developed

- Assessment Engine, http://cvu.strath.ac.uk/ae/

- Clyde Virtual University, http://cvu.strath.ac.uk/ one of the first virtual universities, with Assessment Hall, Cafe, Lecture Hall, Library and Admin Office

- EVA http://bengt2.citu.lu.se/eval/, a web-based evaluation tool for editing questions, publish the evaluation and the results of it on the web.

- ITCampus, http://itcampus.org/, an international virtual student campus with resources collected by students for students to develop the quality of education.

- KNUT, http://knut.kks.se/, Knowledge Network for Education in Schools

- LUVIT, Lund University Virtual Interactive Tool, http://www.luvit.com/, a tool for teachers to create and publish courses on the web, for students to learn and communicate to record student progress

6. References

Bennett, R.E. (1997). *Reinventing Assessment* - ETS Policy Information Center

Bloom, B.S. (1956). *Taxonomy of educational objectives: Handbook of cognitive domain*, New York: McKay

Chung & O'Neil (1997). *Methodological Approaches to Online Scoring of Essays* - CSE Technical Report 461 - Center for the Study of Evaluation, UCLA

Coopers & Lybrand (1998). *The Transformation of Higher Education in the Digital Age* - Coopers and Lybrand L.L.P. April 1998

Cunningham,S., Tapsall,S., Ryan, Y., Stedman, L., Bagdon, K. & Flew, T. (1998) . *New Media and Borderless Education: A Review of the Convergence between Global Media Networks and Higher Education Provision* - Published by the Australian Government's Department of Employment, Education, Training and Youth Affairs. ISBN 0 642 23718 2

European Computer Driving Licence (ECDL) (1999). http://www.ecdl.com/

ICQ (1999). http://www.icq.com/

Kjollerstrom, B. (1974). *Evaluation of all Swedish exams in physics during 1972*. UKA report 1974:22c

Whittington, C.D. (1998). There's More to the Web than Multichoice - *Proceedings of the Second Annual Computer Assisted Assessment Conference* ISBN - 0953321010, pp. 117-123, Loughborough, UK - June 1998

Whittington, C.D. & Hunt, H. (1999). Approaches to the Computerized Assessment of Free Text Responses *Proceedings of the Third Annual Computer Assisted Assessment Conference* ISBN - 0953321037, pp. 207-219, Loughborough, UK - June 1999

An Exploratory Analysis of the Career Enhancing Aspects of an Internet-based Program

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Abstract: Educational initiatives designed to capitalize on the rapid growth of the internet and associated technologies have created the promise of diverse learning opportunities. The vast amount of web-based courseware currently available via the WWW has created numerous opportunities for non-traditional learners to gain valuable career-enhancing training. However, there has been, to date, little research conducted to determine whether web-based courseware has actually been successful in fulfilling it's promise of effectively addressing the career development needs of this population. This paper discusses the findings and implications of a research project conducted on an innovative distance education project at the University of Calgary. In particular, the paper discusses the extent to which the web-based educational program designed to be career-enhancing for non-traditional adult university students was able to meet the program objectives. Implications for web-based courseware in general are discussed.

Introduction

With the rapid growth of the internet and the ability for interactive media-rich on-line experiences, there has been a push to capitalize on the potential of these new technologies as a means for delivering on-line distance learning opportunities [Ibrahim & Franklin 1995]. The enrollment of adult students in higher education programs is expected to increase significantly in the foreseeable future. Given that adult students bring with them the additional responsibilities of work and family, the internet presents an opportunity to provide accessible learning opportunities to meet a growing demand, allowing learners to acquire specialized training, knowledge and skills in the comfort of their homes, workplaces and communities, regardless of geographical locale [Palmieri 1997]. Career development and career enhancement are, by their nature, inextricably bound up with the web of various roles and responsibilities that each individual constructs as part of their "life space" [Super, Savickas & Super 1996]. Adult students, by their very nature, enter the educational process with many 'life-roles' and responsibilities well established. The majority of adult students return to college and university educational programs with the goals of developing more marketable skills in order to earn higher salaries, secure better lifestyles and obtain specific [Rose 1996].

For this reason, on-line learning opportunities offer the potential for radically new career enhancing learning experiences that, it can be argued, may revolutionize education and career training practice by providing a never-before-seen structure for maintaining life balance and overcoming barriers to the preparation phase of the career development process.

Background

The Community Rehabilitation Studies distance education project at the University of Calgary, provides an ideal environment for research in this area. Implemented in 1994, the program offers adult students, working in the field with a two-year college diploma - in seven different locations or "communities of learners" throughout Alberta - the opportunity to obtain the last two years of a Bachelor of Community Rehabilitation degree via distance over a four-year period. The BCR degree allows students to further their career aspirations in their current or related field while continuing to live, work and raise their families in their communities. Since the majority of the distance BCR program students are women, this group also presents a unique opportunity to study the career enhancing aspects of such preparation strategies for the career development needs of women, who are, traditionally, expected to fulfill the bulk of the family child care responsibilities.

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Opportunities for Innovation

With the growth of new communications technologies, there is an opportunity for innovative approaches to counseling, career development and training programs [Sampson, Kolodinsky & Greeno 1997]. Along with the rapid technological developments is a concurrent radical change in the world of work as many companies are changing their hiring and employment practices in an increasingly competitive economy. At no time in history have workers faced such instability in finding secure and safe career paths. Yet, at no time have workers also had a range of opportunities for molding a career that is at once, meaningful, satisfying and fulfilling. The foregoing events signal a need for career training opportunities and career development practice that allow for a more diverse population to access these services that are accessible for individuals of all walks of life, both in terms of cost and in terms of physical accessibility [Hoyt & Hughey 1997]. According to Sampson, Kolodinsky and Greeno [1997], the internet, or the "information highway", may help to overcome the problems posed by distance and time constraints, allowing access to opportunities that are not otherwise available. In doing so, the internet may allow learners facing career barriers the option of choosing to access career enhancing learning opportunities in their homes, communities and workplaces.

There has been a rapid growth in academic institutions offering on-line learning opportunities that are hoping to reach those who cannot or choose not to come to the urban campuses for conventional Monday-Friday programs. These learners could include those already employed and looking to upgrade their credentials without leaving their job or their home community, or those who want new skills or careers but cannot leave home because of child care and family responsibilities [Thompson and Chute 1998].

Preparation barriers

Career barriers are those circumstances which hinder the fulfillment of career plans and goals. According to Manuel London, "career barriers may stem from the individual, the work environment, or a combination of the two" [1997 p.25]. Such barriers may include: disabilities, discrimination due to gender or race, lack of sufficient funds, childcare responsibilities, work location/geography, spousal responsibilities, stress, etc.

A critical component of career planning is the preparation/skill development stage. When an individual has gone through the first three stages of career planning, they are ready to move on to the process of implementing their career preparation action plans. These plans may simply include a decided method for looking for work and preparing for interviews; or, if they are lacking the necessary skills and knowledge to pursue their career of choice, then the preparation phase would begin with the necessary actions to obtain this training and qualifications. Barriers to obtaining this training could include those limitations that would make it difficult for an individual to access and take part in the training programs. One of the present problems is access to specialized training in an increasingly qualifications-dependent world of work. Many specialized training programs are only offered in specific geographical locations. These problems may be exacerbated for women, who have traditionally been expected to maintain the household and family duties even when working full-time, and who, due to discrimination resulting in traditionally lower pay rates than their male partners, may have less say in the ability of a family to up-root and move for educational reasons [Tipping, 1997]. These barriers may also be augmented for disabled individuals who have difficulty with mobility to travel to and attend formal classes.

This model of offering formalized courseware and educational programs over the internet and at a distance to people working and living with their families in their home communities, can be seen as one possible solution to the problem of overcoming barriers to preparation/skill and knowledge acquisition [Hipp, 1997].

Career Development as Maintaining Life Balance

According to Donald Super [1990], another critical component of career development is the task of balancing one's various life roles – one's "constellation of life roles"- that together make up one's "life-space". Super defined life-space as the "constellations of positions occupied and roles played by a person" [p.218]. He believed that these positions and roles combine to create a person's career. Earlier career theories ignored the fact that "while making a living people live a life" [Super, Savickas, & Super 1996 p.128]. While the work role is critical in modern society, it is important to realize that it is only one of many roles that a person occupies that fill up their "life-space". For this reason, people make decisions about the kind of work roles they wish to take on and the training they will engage in to obtain the qualifications for these work roles "within the circumstances imposed by the constellation of social positions that give meaning and focus to their lives" [Super, Savickas, & Super 1996 p.128]. Career development, then, is the process by which "people explore the meanings of these roles implement their self-concepts within these roles, and balance them in a way which is satisfying to the individual" [Robitschek 1997 p.133].

This model of offering formalized courseware and educational programs over the internet and at a distance to people working and living with their families in their home communities, can also be seen as an attempt to balance the various important life roles that make up a person's life space. Furthermore, Super stated that "Multiple roles can enrich life or overburden it" [Super, Savickas, & Super 1996 p.128], while Brown [1996] argues that life satisfaction depends upon balancing a number of life roles that satisfy all of a person's essential values. Adult learners, and in particular those who are parents, have more roles and responsibilities to consider when making career and educational decisions. Women tend to face greater challenges to balance their various roles, without becoming overburdened, while pursuing their career path. According to Fitzgerald, Fassinger & Betz [1995] "women's relationship to work is more complicated than men's.... because of the intertwining of work and family in their lives [p.67]. Given that multiple roles can enrich one's life, internet-based distance education programs can be seen as an attempt, or an opportunity, to enrich people's lives - and women in particular - without overburdening them with the constraints imposed by traditional education, while continuing to allow for collaboration, interaction and media-rich learning experiences.

Summary

It is evident from the research examined in this section that there is a need for exploration and inquiry into the preparation phase career development programs that may enhance the ability of individuals to overcome career barriers and balance their various life roles while in the process of advancing their career paths.

While it seems obvious that increased offerings of training programs should be experienced by learners as career enhancing, there is no evidence to date that these programs actually enable adult learners to overcome career barriers while strengthening their ability to balance their various life roles. Numerous authors praise the benefits of on-line learning, while others caution the potential problems. However, based on the review of the literature, it is evident that very few, if any studies have explored adult learner perceptions and experiences of on-line learning as they relate to their career development and career enhancement needs.

Some educators consider distance education to be one of the solutions to the problems of overcoming barriers and maintaining life balance. However, traditional print-based distance education programs have tended to leave students quite isolated from each other and have, generally, lacked the self-directed conversational type of learning that adult learners prefer. For this reason, highly interactive, media-rich on-line internet-based training and educational programs offer immense promise to transform education, training and career development practice in a positive direction

Method

Subjects

Students who had completed the BCR degree while taking a combination of on-line and in-person courses were mainly adult learners between 25 – 40 years of age who constituted the "post-strategy" group (n=25),. A new group of students who were beginning their program were designated as the "pre-strategy" group (n=40).

Instruments

Surveys were used with both pre and post-strategy groups to collect demographic information in addition to measuring student attitudes, and experiences or perceptions regarding the effectiveness of the internet-based program as a career enhancing strategy.

Procedure

Quantitative data capture and analysis techniques were employed initially with follow-up focus groups to discuss and augment the study findings.

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1) Each student was asked to complete the survey instrument using a Likert scale for quantitative analysis. Other questions asked for short answer responses to identify salient themes and to capture specific examples.
2) Data collected:
For group 1 (post-strategy) – individual perceptions of the *experienced* effectiveness of internet-based training as a career planning strategy
For group 2 (pre-strategy) – individual perceptions of the *perceived* effectiveness of internet-based training as a career planning strategy
3) The analysis explored perceived strategy effectiveness within each group and across groups, in addition to comparing between groups. Focus was also placed on the perceived effect on issues of life balance, overcoming barriers to career enhancement, overall life planning, increased opportunity generation and recommendations for future research.
4) Follow-up focus groups were held with participant volunteers to collect impressions of the survey results and anecdotal information to be added to the study discussion section.

Data Analysis

Descriptive and inferential statistics were used to assess the research questions. These procedures included the reporting of group means, variance and standard deviations for survey questions as they relate to the research questions under investigation. Correlational analyses and t-tests were used to compare survey questions between groups to address the question of differences between expectations/perceptions and experiences between the two groups. Chi – square cross tabulations were used in an attempt to identify student variables that may be possible predictors of the research findings. Short answer survey questions provided were summarized, categorized according to major themes and presented in the discussion. These same questions were used as the basis for follow-up focus groups, from which anecdotal and qualitative data were summarized and inserted into the discussion.

Discussion

According to the expectations of most distance educators, web-based courseware holds he promise of creating new and exciting career-enhancing opportunities for learners who would normally be unable to attend facilities-based classroom programs.

The findings of this somewhat limited study support these assumptions in demonstrating that web-based educational programs can, in fact, provide a valuable career development resource by allowing non-traditional learners access to specific skill training opportunities while continuing to work and live in their home communities. The majority of both pre and post-strategy students rated the perceived and experienced career-enhancing aspects of the program as significant. However, interestingly, comparisons between groups showed that there were significant differences between the perceptions of the pre-strategy group and the experiences of the post-strategy group. Most notably, the pre-strategy students rated significantly higher in their expectations for both enjoyment and performance using the web-based model than the ratings given following the actual experiences of the post-strategy group. In addition, while pre-strategy students expected to spend less time interacting with their instructors and other students during the web-based program, post-strategy students reported spending significantly more time interacting when compared to traditional classroom educational experiences.

Most importantly, the majority of participants in both groups reported that the web-based program enabled them to overcome a number of career-limiting barriers including juggling work, childcare and family responsibilities in addition to geographical distance. In fact, many reported that without the availability of such a program they would have found it extremely difficult to make any progress with respect to their career development needs and desires. However, while the majority of students reported that the program allowed them to maintain the various relationships and responsibilities that together can create a balanced life, they also expressed their overwhelming view that having to juggle coursework in addition to all of there other daily responsibilities added a great deal of stress to their lives.

Conclusion

The general purpose of this study was to evaluate the effectiveness of web-based learning as a career enhancing strategy by collecting the experiences and perceptions of learners who had completed or were embarking on a specific web-base degree program.

The findings of this study, with a limited sample, seem to support the growing assumption that web-based learning programs may, in fact, be a revolutionary delivery mechanism for educational training programs designed to meet the needs of non-traditional learners. However, given the limited nature of this study and the reality that there are a multitude of different methods for offering and teaching web-based programs, there is a need for further research in this area. Specific attention should be focused on determining the elements required to make a web-based program successful in the eyes of the students enrolled.

Benefits of further research in this area may include the emergence of useful information for 1) career counselors who wish to utilize advances in on-line learning technology for suggesting a wider range of preparation phase skill development options; 2) a variety of individuals and groups who wish, or are forced by their circumstances, to find more accessible, geographically independent specialized skill development opportunities in order to further their career opportunities in the rapidly changing world of work; 3) women, disabled individuals, and other groups who may find accessibility to such traditional learning opportunities to be difficult or impossible, given their limitations, child care responsibilities, etc., and; 4) organizations, academic institutions and their administrators who wish to implement more accessible and widespread learning opportunities to a greater number of potential learners.

References

- Book references:

[Brown 1996] Brown, D. (1996). Brown's values-based, holistic model of career and life-role choices and satisfaction. In Brown, D & Brooks, L. (Eds.) (1996). *Career: choice and development: Third edition*. (pp.102-144). San Francisco, CA: Jose Bass, Inc.

[Fitzgerald & Fassinger 1995] Fitzgerald, L. F., Fassinger, R. E., & Betz, N. F. (1995). Theoretical advances in the study of women's career development. In Walsh, W. B. & Osipow, S. H. (Eds.) (1995). *Handbook of vocational psychology: Theory, research, and practice (2nd ed.) Contemporary topics in vocational psychology.* (pp. 67-109).

[Super, Savickas, & Super, 1996] Super, D. E., Savickas, M. L., & Super, C. M. (1996). The life-span, life-space approach to careers. In Brown, D & Brooks, L. (Eds.) (1996). *Career: choice and development: Third edition*. (pp. 121-178). San Francisco, CA: Jose Bass, Inc.

[Tipping 1997] Tipping, L. M., (1997). Work and family roles: Finding a new equilibrium. In Farmer, H. S., (Ed.) (1997). *Diversity and women's career development: From adolescence to adulthood. Women's mental health development, Vol. 2*, (pp. 243-268). Thousand Oaks, CA: Sage Publications, Inc.

- Journal references:

[Hipp 1997] Hipp, H. (1997). Women studying at a distance: What do they need to succeed? *Open Learning*, 12(2), 1997, 41-49.

[Hoyt & Hughey 1997] Hoyt, K.B. & Hughey, K. F. (1997). Career counseling in the knowledge age: Implications for change in school counselor programs. *Journal of Career Development*, 24(2), 1997, 95-102.

[Ibrahim,, & Franklin, 1995] Ibrahim, B., & Franklin, S. (1995). Advanced educational uses of the world-wide web. *Computer Networks and ISDN Systems*, 27, 871-877.

[London 1997] London, M. (1997). Overcoming career barriers: A model of cognitive and emotional processes for realistic appraisal and constructive coping. *Journal of Career Development*, 24(1), 1997, 25-38.

[Palmieri 1997] Palmieri, P. (1997). Technology in education…do we need it? *ARIS-Bulletin*, 8(2),1-5 .

[Robitschek 1997] Robitschek, C. (1997). Life/career renewal: An intervention for vocational and other life transitions. *Journal of Career Development*, 24(2), 1997, 133-146.

[Sampson, Kololodinsky, & Greeno1997] Sampson, J.P., Jr., Kololodinsky, R. W., & Greeno, B.P. (1997). Counseling on the information highway: Future possibilities and potential problems. *Journal of Counseling and Development*, 75(1), 203-212.

[Super 1980] Super, D. E. (1980). A life-span, life-space approach to career development. *Journal of Vocational Development*, 27, 282-298.

[Thompson, & Chute 1998] Thompson, M.M., & Chute, A.G. (1998). A vision for distance education: Networked learning environments. *Open Learning*, 13(2), 1998, 5-11.

- Proceedings references:

[Rose 1996] Rose, T.G. (1996). The future of online education and training. *Online Information 96*. Proceedings of the International Online Information Meeting (20th, Olympia 2, London, England, United Kingdom, December 3-5, 1996 (6p).

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Footprint Proxy – Design And Implementation Of A Framework For Reporting Web Server Statistics

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Abstract: This paper describes a Java-based framework for reporting HTTP server statistics. The framework allows users to view page access statistics as they browse the corresponding pages. By plugging in new analysis packages, the framework can be extended to offer more reporting features and interfaces. System configurations and page statistics are all stored in XML, which makes the framework flexible and configurable.

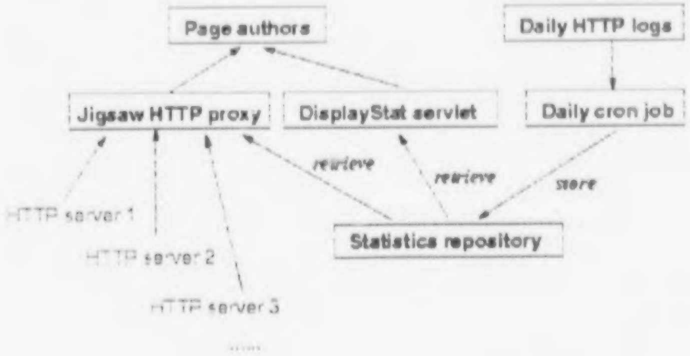
1. Introduction

Web servers generate access logs that contain valuable information for page authors, such as the page URL, remote host, user name for authentication, time of access, referrer name, and client software (browser and operating system). It is desirable that this information be available in a convenient form for authors and web site managers.

Many commercial and free HTTP access log analysis tools exist, such as WebTrends [2], MKStats [3], Wusage [4], WebSTAT [5], and Analog [6]. Those traditional log analysis tools all require authors to visit a special web address in order to view page statistics, and they all impose their own user interfaces. There is no way to change the look of the statistics reports, and there is no way to extend the tools with new reporting functionality without substantially modifying the original source code.

The Footprint proxy described in this paper presents access statistics intuitively by attaching the information to the HTML pages as a prefix; therefore it is easy to correlate the statistics to content. Also, the Footprint framework is dynamically extensible with analysis packages to configure report generation and presentation.

2. Architecture



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The Footprint proxy front-end is responsible for presenting access statistics to page authors, which the back-end computes from daily web server access logs.

The front-end includes an HTTP proxy server and a Java servlet [7] named DisplayStat. The HTTP proxy is implemented by a Jigsaw [8] HTTP server. The DisplayStat servlet can be run within any servlet-enabled web server with access to the statistics repository. When the Jigsaw proxy receives a request for an HTML page from a user, it first retrieves the page from the real HTTP server and the abbreviated statistics of the page from the statistics repository, then attaches the statistics to the page and returns the page to the user. The DisplayStat servlet is used to retrieve more detailed information from the statistics repository. The back-end is run by a daily cron [9] job. It parses logs from multiple HTTP servers and computes data to augment the statistics repository.

Both the front-end and the back-end share a central configuration file, which is defined in XML. The configuration file specifies the analysis package to use, thus allowing different reporting features and styles.

3. Daily Computation And Storage

The statistics repository is a hierarchical store, which replicates the directory structure of the web host: segments in the URL path represent directories. E.g, the statistics for "http://www.research.digital.com/SRC/HPAS/index.html" are stored in the directory "stat-root/SRC/HPAS/index.html/", where stat-root is the path to the root statistics directory of the server " www.research.digital.com".

The back-end cron job runs every day. It first parses the daily log for every HTTP server defined in the central configuration file. The log contains a series of log lines, each corresponding to an HTTP request made to the server. Each log line is appended to a per-page log file. For instance, the file "stat-root/SRC/HPAS/index.html/log" contains all the log lines for the page "/SRC/HPAS/index.html". After per-page log files are built, the statistics directory tree is recursively traversed. While visiting each directory, daily statistics are computed from the per-page log file and stored as an XML file in the directory. Each directory contains up to 31 daily statistics files, which allow the cron job to compute weekly and monthly statistics of the page. On a week boundary, the cron job parses the last 7 daily statistics files and generates a weekly statistics file. Similarly, on a month boundary, the cron job parses the daily statistics files of the last month and generates a monthly statistics file. Up to 12 monthly statistics files are kept in the directory, and on a year boundary, all the monthly statistics files are parsed to generate a yearly statistics file.

We keep statistics files in XML format because they need to be readable, extensible, and easy to parse. XML is a meta-language from W3C, which allows for the definition of new markup languages. We use IBM's XML Parser for Java [10] for parsing and statistics generation.

4. Analysis Packages

The Footprint framework provides a flexible architecture for statistics computation and presentation. For each HTTP server whose log is processed by the framework, a Java package name can be specified as an attribute of the <server> element in the configuration file. Each such package computes statistics and generates a report in a specific format. By merely changing the package name in the configuration file, different statistics reporting schemes can be selected. Since this is server specific, each server's statistics may be computed and reported in a unique manner.

An analysis package must have four classes named DailyStat, WeeklyStat, MonthlyStat, and YearlyStat, all of which implement the fpp.stat.Stat interface:

```
public interface Stat {
  public void generate(String URL_of_page, Server server_config_object);
  public void parse(String URL_of_page, int num, Server server_config_object)
              throws FileNotFoundException, IOException;
  public void html(Writer out);
  public void htmlHeader(Writer out);
}
```

The generate() method generates a statistics file for a particular page in XML. For example, DailyStat.generate() would output to a statistics file named "6.d", if the previous day of the month is the sixth. The parse() method parses a statistics file identified by a number, which represents a day, week or a month. For example, DailyStat.parse() would parse a daily statistics file based on the page URL and the date (from 1 to 31), and stores the parsed information in the DailyStat object. The html() method writes the content of the Stat object as a formatted HTML segment to a character stream. The htmlHeader() method writes an abbreviated HTML segment, which is suitable for displaying in the header of a web page.

The framework dynamically loads the analysis package for each HTTP server. Calls made on the Stat interface are dispatched to the appropriate implementing classes. Since the analysis packages are in charge of parsing and generating statistics files, the file formats may be freely changed or extended by different packages. Note that a significant change in the statistics file format may render previously computed data unreadable. Therefore, by adding or modifying analysis packages, we can extend the framework to support more reporting features.

As analysis packages may need reporting options (level of detail for statistics collected, font and color choices for rendering, etc.). To support this each package may optionally contain a class named Directive, which implements the fpp.config.Directive interface:

```
public interface Directive {
  public void loadFromElement(Element XML_element_to_read_options_from);
}
```

The Directive object is used to define reporting options for the analysis package. The method loadFromElement() fills the content of a Directive object from an XML element. While parsing the central configuration file, the framework will call the loadFromElement() method if an unknown element appears within the scope of a <server> element. It is then up to the implementing Directive object to parse the unknown element to retrieve the statistics options. An example of this is given at the end of section 6 (the "domain" element is parsed by the Directive object).

5. Report Presentation Interfaces And The Jigsaw HTTP proxy

The framework provides two ways to access the statistics information. First, abbreviated statistics can be viewed as authors browse their pages (by inserting the statistics in the beginning of HTML pages). Second, full statistics can be accessed via the DisplayStat servlet.

In the first approach, when a user requests a page through the Jigsaw proxy, the proxy fetches the page and inserts abbreviated statistics after the <body> tag. These are computed by calling calling the htmlHeader() methods of the classes DailyStat, WeeklyStat, MonthlyStat, and YearlyStat of the analysis package specified for the HTTP server.

The HTML statistics header contains a hyperlink for accessing detailed statistics information about the page. The hyperlink points to the DisplayStat servlet. To show more statistics to the user, the servlet calls the html() method of the classes DailyStat, WeeklyStat, MonthlyStat, or YearlyStat of the analysis package specified for the HTTP server.

To support the statistics header insertion mechanism, we implemented a Jigsaw resource filter in the Jigsaw HTTP proxy. The resource filter can be configured to handle multiple HTTP servers. If a page request is not for any of the servers, the filter simply returns the page unparsed and unmodified.

To use the Footprint statistics service, a user simply modifies her browser's proxy configuration to point to the Jigsaw proxy (manually, or via a Proxy Auto Configuration [11] file). Pages from servers defined in the Footprint proxy will be augemented with statistics headers, while other pages will simply bypass the proxy.

6. Sample Analysis Packages

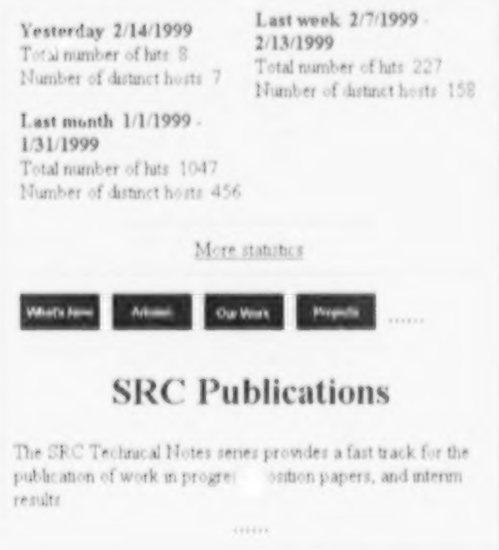
We have implemented two analysis packages to demonstrate how the framework can be used and extended. The first package, "fpp.stat.disthost", lists hits by distinct hosts; the second package, "fpp.stat.domain", lists hits by domain names.

The daily, weekly, and monthly statistics files of the package "fpp.stat.disthost" contain the total number of hits and a sorted list of hits from distinct hosts; the yearly statistics file contains the total number of hits of the year and the total number of hits of each month. Here is the daily statistics file for 2/12/1999:

```
<daily-stat total-hits="43" timestamp="2/12/1999">
  <host name="paprika.wwwcache.ja.net" count="7"/>
  <host name="eec6.pa-x.dec.com" count="5"/>
  <host name="cache-dc13.proxy.aol.com" count="2"/>
  <host name="194.85.254.111" count="2"/>
  ......
</daily-stat>
```

When computing daily statistics, a table of hits indexed by hostname is created by parsing the per-page log file and sorting on the count field. Weekly and monthly statistics are similarly computed by parsing daily statistics files. No table of distinct hosts is built for yearly statistics, as the table might be too long.

When a user browses to "http://www.research.digital.com/SRC/publications/" page (a) below will be displayed:



Yesterday 2/14/1999
Total number of hits 8
Number of distinct hosts 7

Last week 2/7/1999 - 2/13/1999
Total number of hits 227
Number of distinct hosts 158

Last month 1/1/1999 - 1/31/1999
Total number of hits 1047
Number of distinct hosts 456

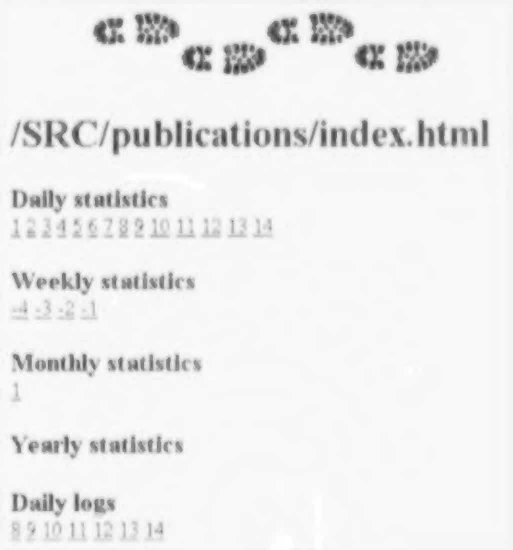
More statistics

SRC Publications

The SRC Technical Notes series provides a fast track for the publication of work in progre[illegible]osition papers, and interim results

......

(a)



/SRC/publications/index.html

Daily statistics
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Weekly statistics
-4 -3 -2 -1

Monthly statistics
1

Yearly statistics

Daily logs
8 9 10 11 12 13 14

(b)

The real page starts after the horizontal line. The header prefix contains a summary of daily, weekly, and monthly statistics, and a link to more detailed statistics. Clicking on "More statistics" brings up the page shown in (b). The page contains links to all the available statistics about "http://www.research.digital.com/SRC/publications/". Daily statistics are available from February 1 to February 14; weekly statistics are available for the past 4 weeks; monthly statistics are only available for January.

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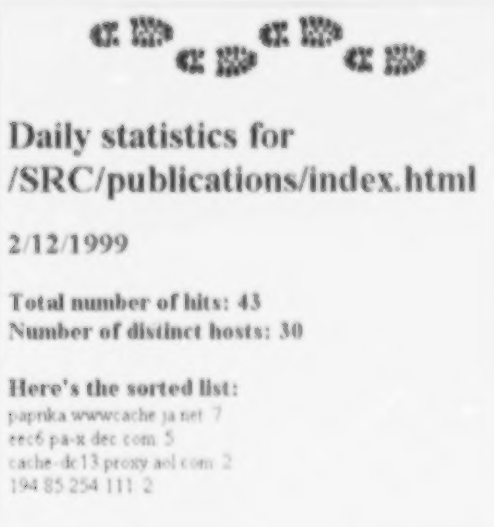
Clicking on the link "12" under "Daily statistics" shows detailed statistics for the page on 2/12/1999 as in (c) below:



Daily statistics for /SRC/publications/index.html

2/12/1999

Total number of hits: 43
Number of distinct hosts: 30

Here's the sorted list:

paprika.wwwcache.ja.net 7
eec6.pa-x.dec.com 5
cache-dc13.proxy.aol.com 2
194.85.254.111 2

(c)

The package "fpp.stat.domain" requires additional configuration directives in the central configuration file, since a list of interested domain names needs to be specified. Here is a sample central configuration file:

```
<fpp>
<server name="http://www.research.digital.com/"
        stat-pkg="fpp.stat.domain"
        log-path="/footprint/logs/research/access_log"
        stat-root="/footprint/stats/research">
  <domain name="com"/>
  <domain name="edu"/>
  <domain name="org"/>
  <domain name="pa-x.dec.com"/>
</server>
<server ...> ... </server>
......
</fpp>
```

Since the <domain> elements are unknown to the Footprint framework, they will be passed to the Directive object of the package "fpp.stat.domain". When computing statistics, hits will be sorted in descending order and listed by the domain names stored in the Directive object.

These are only some examples of the types of analysis packages that one can plug into the framework. More sophisticated packages can be developed and deployed in the same fashion.

7. Conclusion

We designed and implemented the Footprint proxy as described above. This allows authors and web site managers to view page statistics as they navigate their own web site. Developing new analysis packages is a relatively simple process, since the framework provides basic instances of statistics collection and reporting facilities, complemented with an extension mechanism to produce customized reports.

The framework can be used in both the "intra web" as well as the external web of an organization. We have run the Footprint proxy to collect statistics for the site "http://www.research.digital.com/SRC/" since January, using the package "fpp.stat.disthost". The daily log from the site is about 5 Mbytes in average, or 25,000 hits. The per-page log distribution and daily statistics computation take about 10 minutes on a 433 MHz AlphaStation running Digital Unix 4.0D. On a week boundary, the weekly statistics take 10 more minutes to compute, and on a month boundary, the monthly statistics need about additional 30 minutes. Once generated, statistics can be rapidly presented via the DisplayStat servlet.

Currently, statistics generation is relatively slow. For a daily log of 50 Mbytes, or 250,000 hits, it would take the system 100 minutes to finish the per-page log distribution and daily statistics computation. In the future we will focus on performance issues and scalability.

8. References

1. Tim Bray et al. *Extensible Markup Language (XML) 1.0.* February 10, 1998. http://www.w3.org/TR/REC-xml
2. *WebTrends.* http://www.webtrends.com/
3. *MKStats.* http://www.mkstats.com/
4. *Wusage 6.0.* http://www.boutell.com/wusage/
5. *WebSTAT.* http://www.webstat.com/
6. *Analog 3.11.* http://www.statslab.cam.ac.uk/~sret1/analog/
7. Sun Microsystems, Inc. *Java Servlet Specification*, version 2.1. http://www.javasoft.com/products/servlet/2.1/
8. World Wide Web Consortium. *Jigsaw Web Server.* http://www.w3.org/Jigsaw/
9. Cron. Unix manual pages, section 8.
10. IBM alphaWorks. *XML Parser for Java, version 1.1.9.* http://www.alphaWorks.ibm.com/formula/xml
11. Netscape Communications Corporation. Using the Client Autoconfiguration File. http://developer.netscape.com/docs/manuals/proxy/adminux/autoconf.htm
12. J. E. Pitkow and K. Bharat. WEBVIZ: A Tool for World Wide Web Access Log Visualization. *1st International World Wide Web Conference*, Geneva, Switzerland, May 1994.
13. L. D. Catledge and J. E. Pitkow. Characterizing Browsing Strategies in the World-Wide Web. *3rd International World Wide Web Conference*, Darmstadt, Germany, Apr. 1995.
14. Papadakakis, N., Markatos, E.P., and Papathjanassiou, A.E. Palantir: A Visualization Tool for the World Wide Web. *INET '98.*
15. Abrams, M., Williams, S., Abdulla, G., Patel, S., and Fox, E.A. Multimedia Traffic Analysis Using CHITRA95. *ACM Multimedia 95.* November 5-9, 1995.

Providing Rated Documents on the Net

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Abstract: This paper aims at representing an initial study assessing the problem of how to find valid and pertinent information from the Internet. We describe a trade platform prototype for certification and validation of digital documents. Our objective is to provide a service that can handle a user's query about document validity on the Internet with added quality information. It is therefore necessary to create tools and mechanisms to allow experts to certify information (inalterable certificate: Digital signature). Those experts will be selected according to their profiles (Expertise fields) and skills. They should give their opinions (labels) on either document existing on the Internet or on specific documents presented to experts for evaluation. Service providers and Internet Certification Bodies should first come to an agreed platform or a standard in order to ensure the credibility of the documents dealt with. We offer a general certifying service architecture. This must take into account the existing mechanisms implemented on the Internet, such as those proposed by X509 for certification aspects, PICS (Platform for Internet Content Selection) for the label model, and technologies of encryption (RSA, MD5) to ensure the signature and the integrity of the document.

Keywords: data quality; evaluation; validation; labels; security

1. INTRODUCTION

Because of the huge amount of information available and the freedom of access, Internet users might think they can find anything on the net, and that what they find is credible. Nevertheless, the issues are now how to choose high quality and relevant information and how to handle the mediocrity of documents on the Internet.

In the future the trade will consist in providing valid credentials, reliable, authoritative and pertinent information and guarantees on its nature, content and source to the users, who will then be able to trust Internet documents.

The quality of information is not only defined through its selection or validation; it also depends on how you select among the various opinions available for any given piece of information. The initial goal of this project is to provide the general architecture of an Added Value Service, independent and with multiple controls, able to validate and to certify digital documents according to evaluation criteria previously established. Thus, it will be necessary to implement tools, capable of providing users, with opinions and ratings about the content and reliability of documents, from renowned experts, each belonging to their respective fields. The design includes a database containing the accurate data after it is rated and validated by the experts, accessible from a search engine through a defined request (topics, scope of use...).

2. RELATED WORK :

Work associated with such a service refers to projects which focus on evaluating educational web sites and making these results available to teachers who wish to make the best of these sites. It also aims at extending and developing the notion of a Universal Design Criteria for Educational World-Wide Web sites that can then be used to guide the creation of future educational websites, such as [Poland et al. 98].

Concerning the quality of information, a number of research works have considered criteria for the evaluation of the Internet information sources. Most of them take traditional criteria as a starting point, but there are particular aspects and concerns in the Internet environment that cause some new criteria to arise [Rettig et al. 96]. Besides, the selective gateways add value to Internet information because users can choose resources from the Internet with regard to subject matter or criteria of quality [Adam. 96].

To assist auditors assessing data quality, both formal and judgement-based approaches have been used for Accounting Information Systems [Kaplan et al. 98]. Some work focuses on rating services whose the reason is filtering systems against boring and dangerous web sites such as SafeSurf [Resnick. 97].

3. THE SERVICE COMPONENTS :

The service will be designed to respond to two kinds of user requests [Fig.1]:

- The list of a previously reviewed documents about precise subject,
- The assessment of a given document.

In both cases, the service will have to indicate the possible framework of these evaluated documents. Indeed, the relevance of the answer to a request depends on its accuracy and clarity.

However, how can we represent the level of accuracy of validated document in terms of subject,

quality, domain, sub-domain, and formulate the query so as to extract more detailed information on the related query? In this case the service will work on two different levels to answer the request.

First on a local database containing a large catalogue of documents already validated and rated, and second on the Internet, following the model of a search engine in the case when users are not satisfied with the query results, or when the service wants to offer an exhaustive research of documents. When a document is submitted for validation, the concerned experts will validate and label this document. The experts can have a different opinion or assessment on a given document (It is interesting as a first step to find a way to generate a final document rating in the form of points and crediting them to the document's score).

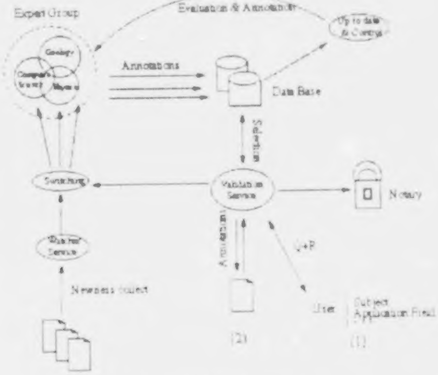

Figure 1: Service description

The service will be updated and operated 24 hours a day, 7 days a week. The support team will operate with shifts around the clock, the off peak hours team will have the duty of searching new documents on the internet and submitting them to the experts for validation (it is important to keep the labeled documents updated to detect any changes made and check the links on the search engine). If any document alteration is found, the document will be resubmitted to the concerned experts later on by the peak hours operating team.

Users who have requested the information will be updated with the changes (this is an optional issue for a limited period of time). In the case when users are not satisfied, the service will request other experts for a validation.

This service will include the infrastructure of other different expert services (education, science, health...) complementing the main service. The service will provide the web infrastructure, including secure facilities, technology (security protocols, cryptography, and secure e-mail 24 hours 7 days a week, redundant system…), as well as customer support.

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A code of practices based on a trusted model will provide online electronic credentials legally binding the users and the experts by contract within a framework defining mutual responsibilities.
On line verifications of the payment are performed once the digital contracts are signed. These verifications are built upon emerging technologies such as Java, modern cryptography techniques.

3.1 Annotations

The validation of the Internet document will be labeled (label is a set text information related to the document proprieties and contents, it can be included in the document or related document or stored onto a database). This label can be represented with different mechanisms [Schickler et al. 96] such as RDF [Lassila et al. 96] (*Resource Description Framework*). RDF is a set of specifications, which allow metadata applications to be combined and to operate with a common way of expressing the semantics, which they share. RDF is a further layer in top of XML. Currently there is not only a large industry on applications to put information from legacy information systems onto the web, there is also an industry in applications which surf the web and, programmed with some idea of how the web pages were automatically generated, retrieve the information and reconvert it into hard well-defined machine-processable data. RDF will allow this long route to be short-circuited, and allow programs to gather data directly. Dublin Core [Weibel et al: 97], another mechanism, is a 15-element metadata element set intended to facilitate discovery of electronic resources. Originally conceived for author generated description of Web resources, it has also attracted the attention of formal resource description communities such as museums and libraries. PICS (*Platform Internet Content Selection*) [Resnick et al. 95, Miller 96] is a mechanism in use in several web servers, it offers a simple labeling format. It is a resource which gives the Internet user the possibility to associate data to the documents. It does not include a text but only the URL of the document containing the text.
A PICS label can describe all the characteristics of a document or a web site; it can be specific or generic. The PICS labels are issued from an independent authority and the document authors have no control on them. It has a proven reliability when it comes to detecting indecent web sites content (nudity, violence, etc), even in the documents indexing (label containing the subject of the documents). In our case, this description mechanism can be chosen among the others, because it is already in use on the Internet and it is possible to adapt it easily to our usage. It corresponds to the desired format for the expert's opinions. Once generated, the PICS labels will be stored onto a database and when a request is submitted, the service proceeds to the selection of all the documents related to that request. Note that different PICS labels can correspond to the same document, and consequently to one or more different opinions.
Our starting point is to know about the value of the information in terms of usage and utility. The evaluation criteria are established by the experts depending on the quality of the information, its application fields and the various possible uses of the document, which contains this information.
Other information can be added to the document including the expert's identity and selected profile.

3.2 Evaluation criteria :

We need criteria to use in evaluating the information found on the Internet because knowing how to judge the quality of those resources is even more important than to find them.
Many Internet sites that select and review Internet information resources rely on subjective values of style. In our work, we focused on information content and it is the experts who determine the information's quality based on style definition, contents accuracy control, public audience, source of the document, author... [Grassian 98]
Some of the criteria listed from different sources set up by librarians, which are used in the evaluation of books, journals, and other resources [Roscheisen et al. 95], are appropriate for our needs.

Authorship and Publishing Organization:
- The Identity of the author (who is providing this information?)
- His reputation and credentials (is the author qualified to write the document?)
- What is his experience in the field?
- If the author is not recognized, does another author or another respected source cite him?

- Is the name of the organization, which is publishing the document, recognized in the field?
- Is the author affiliated with particular organizations or associations?

The Scope:
- What is the scope of the information?
- How broad and deep the content coverage is?
- Is the information on target with its purpose?
- Is there any point of view or bias in the information? Are they noted in the document?
- Who is the target? Is it clearly stated in the document?

The Content:
- Is the content of resources objective?
- Is the information original?
- Does the information conform to its title or keywords (original aim of its author or site)?
- Is the information current? (Date of creation and last update)
- Does the document compare well with others on the same subject?
- What is the source of the information?
- Is the information reliable, truthful?
- Is the information revised?

These are few questions extracted from a full guideline, which will be used by the experts, or the known subject specialists about the topic. The experts must determine the information of a document using their knowledge and their judgement.

In general a Label is trusted only if the author has issued a digital signature [Lipp et al. 98] from a trusted third party (Certificate Authority). It is then possible to apply the X509 norm [X509], which acts as a framework for providing the authentication through the X500 [X500] directory, and the distribution of the public keys for the service users. This directory should be able to responds to the users authentication needs (PKI: Public Key Infrastructure).

Every expert will have a unique name in the directory listing, assigned to him by a trusted third party authority. A part of the label must contain a crypted digital signature of the document in question, giving the possibility to verify the integrity of the document or its obsolescence.

3.3 Expert/Client's description

A trusted service provider will recruit experts who will be chosen on the basis of their areas of competence, and on the credibility and a high standard of morals; they will be legally bonded to the service provider. A list of experts by domain will be established and made available to the subscriber to query.

Proficient mechanisms must be setup to avoid frauds. The digital signature of the certifying expert will be issued on the document involving the responsibility of the expert. The user will be able to access the service by formulating an accurate request.

In fact the precision of the answer provided by the service depends heavily on how precise is the request. The user interface will contain a main menu organized by topics of domains, sub-domains, and any useful information, which can help to extract other information about the request.

Prior to use of the service, a legal agreement for the subscriber's activities is recommended. Users accounts will include an activities log to avoid any fraudulent use, or dispute, and a feedback system will be used to inform the customer on the latest updates, and giving the possibility of feedbacks of comments on the service quality from the clients.

4. THE SECURITY MODEL

It is important to see how to secure a transaction between the client and the service [Shneider 96], the labels (annotation) emitted by the experts to the clients, the payment transaction from the client to the service, and finally a certification issued from the service to the client (including the issued certificate and the key enabling the decryption of the first message). Several security systems exist nowadays several security systems. The most interesting solution is to design and implement a sort of secure envelope containing the crypted contents, and the most important is to deploy and activate other security functions related to the e-commerce, crypting and digital signature. The crypting makes the content of a transaction more secure on the network. It will be based on the principle of the asymmetric crypting algorithms, RSA [Rivest et al. 78]. This is a public key and private key coding. This secure envelope will contain in itself the public key used to crypt its own contents. The private key, which will be used to decrypt the envelope content, will be delivered by a trusted third party (Independent Authority). Its role is to deliver it to the clients once they accepted to pay and the requested service delivered the necessary decryption key. In our case, the digital signature has as main goal the authentication of the client and the service (even the experts), the integrity of the transaction and the non-repudiation.

The annotation of the document involved by the user has an encrypted form. Upon agreement and signatures of the contract by the user, the key is forwarded to unlock the envelope containing the label.

5. EXCHANGES SECURITY

Security controls must be established to protect the exchange of information between the client and the service. These measures must comply with the OSI model X.800 [X800] and provide:

- Authentication: which has two levels. First the process which verifies the identity of the person that logons to the service, and only the user who paid for the service should have access to it, and the second when a client uses the service he must be able to verify the expert identity, who validated the document.
- Integrity: in general, any sensitive information must be protected from any form of forgery. Therefore, it is essential to implement measures to prevent users from make any documents modification during the service session.
- The Non Repudiation: the engagement taken by the experts during their session must be proven and verified. The origin of the document must be provided by the expert and ascertained in the sequel. Proof of the origin of document is required (the expert is accountable for) to protect the client from any denial from the service provider for issuing the document. This will be the proof of receipt to protect the service provider if the client denies the document reception (During an update, for example).

6. THE PROTOTYPE SYSTEM

A first prototype version of the service has been implemented and is able to respond user query about document concerning environment [Agora21].

The digital contract, once signed, may first travel to the server hosting the annotation about the referenced document. When the document is available, the digital contract will be moved to the notary server, which will check if the user who signed the contract is a member, and finally travels to the online payment service to complete payment.

With regard to the evaluation, the document evaluation is done through a questionnaire that the expert has to fill-in depending on the indications provided.

In order to allow the evaluation of the documents, a form generator has been elaborated. The form is a whole of questions that the expert will answer. The form is enriched with a descriptive text regarding each question and the meaning of the related answer in order to guide the expert in his answers. This description is written in XML (eXtensible Markup Language) [Bradley 98]. XML is concerned with describing the content of documents that are stored in electronic format. It is an ideal format for a structured and semi-structured representation of data. The form itself is generated after a compilation of a QAML description (Query Answer Markup Language). Once the form is filled, the expert, the expert will have to submit this form to an HTTP server, from which a cgi-script runs. This script is designed to store the information provided by the expert into a Mini SQL Data Base, the information provided by the expert. The scripts are written in LITE (mSQL's Scripting Language).

7. CONCLUSION

At present the information available on the Internet in mainly free. Information of all sorts (inaccurate data, sometimes obsolete) is accessible by all the users. There is a need for information credentials, of good quality for the user ready to pay for its accuracy. This work is based on the need to offer a validation service, giving a guarantee on the nature and the origin of any document on the Internet.

This paper attempts to provide an overview of such a service and the state of art of tools, which can be implemented. A first prototype evaluates WWW sites that specialize in Environment [Agora21]. Therefore, in adapting traditional criteria to the document on the Internet, a list of evaluation criteria has been defined to determine the quality of information including reliability and credibility checking of the document. This list may be extended because of the changing environment of the Internet.

REFERENCES

[Adam. 96] ADAM Site. Art, Design, Architecture and Media Information Gateway (ADAM). Available at http://adam.ac.uk/adam/. November 1996

[AGORA21] AGORA21. Environment Site. Ecole Nationale des Mines de Saint-Etienne. Available at http://www.agora21.org

[Bradley. 98] Bradley, N. The XML COMPANION. (1998). Addison-Wesley Edition.1998.

[Grassian. 98] Grassian, E. (1998). Thinking Critically about World Wide Web Resources. UCLA College Library Instruction. 1998.

[Kaplan et al. 98] Kaplan, D., & Krishnan, R. (February 1998). Assessing Data Quality in Accounting Information Systems Communication of the ACM. Volume 41, Number 2.

[Lassila et al. 96] Lassila, O., & Swick, R. (1996). Resource Description Framework (RDF) Model and Syntax Specification-W3C. http://www.w3.org/TR/WD-rdf-syntax-971002.html. October 1996.

[Lipp et al. 98] Lipp, P., & Chu, Y-H., & Desautels, P. (1998). PICS Signed Labels (DSig) 1.0 Specification. W3C RECOMMANDATION. May-1998

[Miller. 96] Miller, J. (1996). PICS Label Distribution Label Syntax and Communication Protocols. W3C Recommendations. October Paris.1996.

[Poland et al. 98] Poland, R., & Thornton, P. Weval - Educational Web Site Evaluation Project. University of Exeter, School of Education. Available at http://www.ex.ac.uk/telematics/Weval/. 1998

[Resnick et al. 95] Resnick, P., & Miller, J. (1995). PICS, Internet Access Controls without Censorship.W3C Boston.

[Resnick. 97] Resnick, P. Information Filtering. Revue pour la Science Numb 2351.1997.

[Rettig. 96] Rettig, J. (1996). Beyond Cool: Analog Models for Reviewing Digital Resources- PARIS.France. Septembre 1996.

[Rivest et al. 78] Rivest, R.L., & Shamir, A., & Adleman, L. (1998). A Method for Obtaining Digital Signatures And Public-Key Cryptosystems. Communications of the ACM. Volume 21, No 2, PP 120-127. February 1978.

[Roscheisen et al. 95] Roscheisen, M., & Winograd, T., & Paepcke, A. (1995). Content Ratings and Other Third Party Value-added Information Defining an Enabling Platform Stanford Integrated Digital Library Project. D-LIB Magazine. October 1995.

[Schikler. 96] Schickler, M., & Mazer, M., & Brooks, C. (1996). Pan-Browser Support for Annotations and Other Meta-Information on the World Wide Web. Paris-France May-1996.

[Schneider. 96] Schneider, B. Cryptographie Appliquee - Thomson Publishing.1996.

[Weibel et al. 97] Weibel, S., & Lagoze, C. (1997). Dublin Core Metadata. http://purl.oclc.org/docs/metadata/dublin_core. November 1997.

[X509] X509. CCITT Recommendation: The Directory- Authentication Framework.1988

[X500] X500. CCITT Recommendation: The Directory-Overview of Concepts, Models and Services.1988.

[X800] X800. CCITT Recommendation: Data Communication Networks: Open Systems
Interconnection (OSI); Security, Structure and Applications Security Architecture for Open Systems Interconnection for CCITT Applications (ISO 7498-2). 1991.

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Short Papers

Dealing With Structured Documents In Information Retrieval Systems

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Abstract : *With the increasing acceptance of XML in the WEB and digital libraries domains, the need for information retrieval systems (IRSs) dealing with structured documents is evident. Taking into account the structure has strong implications in the whole process of an IRS, from the creation of the document corpus until the query language adopted by the system. In this paper we are interested in expliciting these implications and proposing how the performance of an IRS may be increased taking benefit from the structure.*

1. Introduction

In the 80s, there has been a growth of interest in applications involving structured documents. In this context, two important developments are the ODA (Office Document Architecture) and SGML (Standard Generalized Markup Language) ISO standards. Since 1997 the W3C works in the development of XML, meta-language based on SGML functionalities. All these propositions explicit the logical structure of the documents by embedding tags in it.

In this paper, we are interested in the way that the structure knowledge can be exploited for improving the performance of Information Retrieval Systems (IRSs). The structure may be helpful to the retrieval process in three aspects. First, as the structure allows the document to be decomposed into different elements, specific indexing methods may be applied according to the different element types. Second, since the structure permits the document to be viewed as a set of elements, the response for a query may comprise only some elements of the set rather than the entire document. On the one hand the user may ask explicitly for specific parts of a document (if he knows the structure). On the other hand, rather than return a whole document, the system may find itself more suitable to return a part of it. Third, the simulation of contextual queries is possible. In a XML document, the context of one element may be determined by its inclusion relationships with other elements. With the advent of XML, the possibility of structured documents circulating in the WEB is becoming real and thus new methods for indexing, evaluating and querying them must be developed. Implications of dealing with structured documents for the design of the different phases of an IRS are dealt in the next sections.

2. Building the corpus

One difference between a typical IRS and an IRS dealing with structured documents can be observed in the corpus of documents to be indexed. The corpus of documents in a typical IRS is a set of documents not related to each other. In terms of granularity, all the elements of the set are situated in the same level, i.e. the documents are seen in a flat way. IRSs applied to the WEB such Altavista consider one single granularity of data, the HTML page. On the other hand, IRSs dealing with structured documents have a corpus whose elements have different levels of granularity and are related to each other by inclusion relationships. A document whose logical structure is represented by a tree-hierarchy of "n" nodes, is translated in the corpus into "n" new documents related to each other by inclusion relationships.

3. Indexing structured documents

Structured documents are represented and described by three features : the structure, the external description (attributes) and the content. The structure is represented by a tree-hierarchy whose arcs correspond to inclusion relationships between the nodes (notion of context). The external description is a set of attribute-values pairs such as author and date. The attributes may be static or dynamic. Static means that the values associated to these attributes are local. Dynamic means that they are propagated upwards and/or downwards. Each feature of a document may be associated with a specific indexing function depending on its type. Usually, the attributes are of the same type whatever the document type (image, text, video) and are thus indexed by a single function. However, the content feature should be indexed differently depending on its type (image, sound, text, etc.).

Let's assume three structured documents, *d0, d1* and *d2. d0 is composed of d1 and d2* (two granularities) and their virtual indexes are *I'd0, I'd1* and *I'd2*. They are virtual because depending on the approach used to index a structured document (replication or not of the data), real indexes have to be defined later during the evaluation phase. To build the indexes of these three documents four possibilities exist : replicate the content and attributes along the tree, replicate only the content, replicate only the attributes, not replicating at all. The choice should be based both on the tradeoff between the index access time and the storage requirements and on the type of the documents and subdocuments. In the case where the indexes of different document types (chapter, reference, figures) are expressed in different indexing languages, they cannot be kept together in the same index structure.

4. Evaluating queries against structured documents

To calculate the similarity between a document *d0* of the corpus and a query *Q*, the IRS uses an evaluation function f_ev. Suppose that *d0* is composed of *d1* and *d2*, and that their indexes are *I'd0, I'd1, I'd2*. The equations below stress two different models for the evaluation function.

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Sim(d0,Q) =  f_ev(Id0,Q) (I)      or
Sim(d0,Q) =  f (f_ev(I'd0,Q), f_ev(I'd1,Q), f_ev(I'd2,Q)) (II)
```

The first model (I) applies to *Id0*, the real index of the document *d0*. If the indexes have been previously propagated, *Id0* = *I'd0* at the evaluation time, otherwise *Id0* is computed thanks to the structure feature of the index *I'd0*, i.e. *Id0* = *I'd0* <+> *I'd1* <+> *I'd2*. Here we suppose that *f_ev* is common to all subdocuments of *d0* and the operator <+> that sums up the indexes is defined. The second model (II) addresses multi-typed components of a document. In this situation, both the indexing function and the indexing language may be different according to the type of the components. Let's *d0* be of type text with subdocuments *d1* and *d2* of type image and sound respectively. The evaluation function then results from the combination of the *f_ev* applied to each document, say *d0*, *d1* and *d2*. It may be a weighted average where the system or the user associates a weight to each type of document in order to quantify the relative importance of the types between them.

5. Querying structured documents

In this section, we show how the structure can be exploited to enrich query functionalities. Let's assume that the "structure-induced" modifications have been taken into account in the creation, indexing and evaluation phases. In the following, we cite three functionalities an IRS taking into account the document structure can offer..

First, the answer of the system may be composed of documents not having the same granularity. The granularity of the documents responded (a chapter, a section, an image, etc.) may be not established in the query but determined by the IRS itself at the evaluation time based on exhaustivity and specificity criteria. It may be extremely useful when the documents are not typed or/and when the user doesn't know the structure of the documents. For example, instead of responding a whole encyclopedia, the system can respond a subpart of it. Second, the user can formulate contextual queries. For example, the query "Find documents about spine in the context of orthopedic" may be formulated. Third, the user can formulate multi-typed queries. This query may be decomposed into sub-queries and the system may evaluate each of them separately. For example, "Find books or chapters about "medicine" containing an image like <image_input>". The user and/or the system may associate weights to the different parts of the query. These weights have an influence in the evaluation of each part.

6. Related work

IRSs described in the literature take benefit from the logical structure in different phases. The passage retrieval [Kaszkiel & Zobel 97] is a domain where the structure is only used during the creation of the corpus of documents. The structure may be also utilized both in the corpus creation and indexing phases. For example, a system may exploit the structure in the presentation of the results in order to permit the user to situate the documents retrieved in the document space. Indeed, this may be very helpful to the user as he can disregard one response straightaway depending on its locality in the "document space". For instance, Yahoo responses are presented with their corresponding place in the context hierarchy. The structure may also be used ii the query evaluation phase. Yahoo and Altavista rank higher sites with keyword matches found in the title than those found in the comments, body, or URL. Query languages adapted to IRS dealing with structured documents must allow access to the content, structure and attributes of documents at any level within their structure. We can find in the literature SQL-like languages (data represented in the relational model), OQL-like (data represented in the object-oriented model) and some specific languages such SGQL (Structured Generalized Query Language) [Moore et al. 95] that manipulates documents represented using the ELF model.

7. Conclusion

The structure is a document component as well as the content. They both reflect the document's semantics. However, just the content is considered by typical IRSs. The interests and implications of using the structure through the different phases of an IRS were shown. They are related to the building of more powerful indexes suitable to multi-typed documents, the combination of evaluation functions on documents multi-typed and query languages supporting more complex requests. We suggest how the system can benefit from an indexing function applied to logical parts of documents instead of to the overall document and the implications of it in the evaluating function. We also outlined that according to the element types of the documents and to the tradeoff between the index access time and storage requirements, different index structures can be used. Finally, the request phase is enriched thanks to the possibility of expressing contextual requests, multi-typed requests and to the fact that results are function of the granularity of information either asked by the end-user or dynamically determined by the system at the evaluation time.

References

[Kaindl et al. 98] Kaindl, H., & Kramer, S., & Afonso, L. M. (1998). Combining Structure Search and Content Search for the World-Wide Web. *Hypertext Conference,* 1998, ACM

[Kaszkiel & Zobel 97] Kaszkiel, M., & Zobel, J. (1997). Passage Retrieval Revisited. *Twentieth Annual International SIGIR Conference on Research and Development in Information Retrieval,* 1997, ACM.178-185.

[Moore et al. 95] Arnold-Moore, T., & Fuller, M., & Lowe, B., & Thom, J., & *Wilkinson, R. (1995). SGQL (Structured Generalized Query Language). Sixth Australian Database Conference*, 1995.

Using Web-based Technology to Improve Student Academic Support: Building an On-Line Tutor Scheduling Application.

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Abstract

The great promise of web-based technology is to provide effective personalized educational content. Providing students with personalized feedback and support is a difficult and time-consuming task for any instructor. It is even more difficult when enrollment is high and students are relatively inexperienced in the substantive area. In one such introductory technology course in the Kelley School of Business at Indiana University, the instructional staff has developed an academic support system using web technology that is now built into common server software packages. The results have been well received by both students and instructors. These consistently positive results have not been without problems. In this paper we describe the support system, identify the problems and some of the solutions, and explore possible extensions of this work.

Background

The Kelley School of Business at Indiana University requires all undergraduate students to demonstrate proficiency in working with spreadsheet and database applications software, and to display a basic understanding of the importance of information systems technology in business. Most students accomplish this by successfully completing the introductory technology foundation course for students entering the School of Business.

The significant increase in student enrollment has been keenly felt. Five years ago the introductory technology course was comprised of thirty-two sections per year. This year we will offer and fill over ninety sections. The demand for this course is substantial. Prospective business students, as well as students from other schools within the university pushed enrollment above one-thousand four hundred students for the Fall 1998 semester. This level of enrollment requires forty-two lab sections and six lecture sections, utilizing thirty-four instructors and more than sixty other support personnel. This steady increase in demand has required increasing attention to course administration, instructor training and evaluation, and the leveraging of information technology to continue to bring students a measurable high-quality instructional product. We have been innovative in our strategies for administration and teaching. An example is the course web site and the support system built into it. The web site provides students with access to course information and resources; distributes assignment, lab and tutorial files used in the course; and is the tool used to coordinate access to help and support for students.

One component of this support system is a one-on-one peer tutor program. Peer tutors are students who have successfully completed the course with a B+ or above. Most peer tutors are assigned to provide classroom support under the supervision of an instructor. Peer tutors with at least a semester of experience and the recommendation of their former instructor supervisor can be assigned to provide intensive individual tutoring to students in the one-on-one tutoring program. There are currently thirty one-on-one peer tutors assigned to sixty-one different one-hour sessions per week. While this program has been in place for several years, managing the process was a very labor-intensive process. Even with the widespread use of email, there was general discontent on the part of both the students (clients) and the peer tutors (service providers), primarily around issues of scheduling, matching, and notification. This general discontent deeply affected the potential of the program and turned a good educational initiative into burden for staff and students alike. Web-based technology has driven a process improvement that has substantially addressed the problems and allowed students to begin to realize the real potential of the peer-tutoring system. The result is an online tutor scheduling application, described below.

Description of System

The course web server runs on Windows NT 4.0, so Active Server Pages was a natural development platform. Furthermore, given the size of projected demand for the system, a decision was made to use the Access database as the engine of the scheduling application. While this application has worked well with the Access engine, other more demanding applications have prompted us to begin the migration of this system to a larger database platform.

An automated on-line scheduling system is used to match students with peer tutors. A student logs into the password protected web site and selects the one-on-one tutor scheduling system. If this is the first time a student has registered for a tutoring session, information is taken about the student's experience with computers and the software used in the course. A student selects the week they are interested in receiving assistance. The student selects the day of the week and then they may select a time period or select a particular peer tutor if that tutor is available. The student is then taken to a screen where they can enter a description of the problem, making it possible for the tutor to prepare for the session. When the information is completed, the student submits the tutoring request. A match is made in real time and all the necessary changes are made to the schedule of tutor availability. The application then generates an e-mail message that is sent to both the student and the tutor confirming the scheduled session and the topic to be covered. It is also possible for the system to be modified remotely by tutors, who may need to adjust their schedule. After the date of the scheduled session has passed, the scheduling application automatically sends a follow-up message to the student inviting comments, both structured and open, about the tutor session.

Results

The web-based scheduling application greatly enhances our ability to provide quality academic support to our students. It provides students with real-time information about the availability of help, prepares tutors for the session, grants students and tutors the flexibility to change appointments, and dramatically decreases the administrative work required to maintain the system. Descriptive statistics based on actual system use as well as self-reported measures of satisfaction will be presented as supporting evidence of the positive student response to the application.

The development and implementation of this scheduling application has also allowed several insights into both its existing problems and its potential for improvement. We are currently working on improving the remote administration features, allowing tutors and program administrators more control over system changes. We are also looking for a more effective way of evaluating and summarizing the follow-up email responses. Another area of improvement involves the scalability of the application. As the demand for the system increases, it is clear that the database engine will not be adequate. This will require a platform migration, most likely to either Oracle or SQL server.

The most significant improvement, however, will involve an extension of the application beyond its mere administrative function. In its current iteration, this scheduling system is solely an administrative tool. While this tool has served its purpose, the next major development of this application is to use the web technology to actually provide tutoring content. It is our hope that this content could be cataloged, reused and reviewed by students with similar problems. We are currently working on ways in which this can be effectively done on a large scale. To date, we have identified two possible approaches. The first, with relatively low bandwidth requirements, uses a slightly modified discussion-thread approach to provide a text-based tutoring session. While this could be easily delivered, cataloged, archived and re-delivered, there are some questions about the efficacy of the results. This is especially true when the substantive focus of the tutoring session is on the hands-on use of technology. The second approach requires the use of more advanced collaborative technology, and comes with an increase bandwidth requirement. This technology allows file sharing, the use of an electronic whiteboard, and one-on-one videoconferencing technology. The expected benefits and costs of these project extensions will be discussed. Examples of the scheduling application and the possible extensions will be provided.

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Web-based Study Environments: Online Digital Collections Designed to Promote Authentic Historical Inquiry

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Abstract. This paper describes a web-based study environment on Spanish colonialism designed to support sustained exploration of online primary source documents for the purposes of authentic historical inquiry. Design, development, and evaluation of the web-based study environment is being conducted by the Center for Advanced Technology in Education at the University of Oregon, funded by the National Endowment for the Humanities.

Introduction

"Web-based study environments" are online collections of primary source documents interlinked in ways that promote sustained exploration, in-depth examination, and authentic inquiry. Web-based study environments provide students and scholars with digitized collections of normally inaccessible materials and support those materials with specially designed navigational features and educationally relevant hypermedia resources so as to enhance comprehension and extend learning. The Center for Advanced Technology in Education at the University of Oregon is engaged in a multi-year research and development project funded by the National Endowment for the Humanities to design, develop, and evaluate a web-based study environment appropriate for teaching and learning in the humanities. It is experience from this project that serves as the foundation for the present paper.

Use of the Internet for the purposes of providing access to materials that enrich and enhance the curriculum is no longer a novelty. Unfortunately, many online digital collections or websites providing archives of educationally relevant materials are not structured or supported in ways that facilitate progress toward instructional goals. The purpose of this paper is twofold: (a) to describe the design, development and evaluation of a specific web-based study environment created to support the teaching of historical inquiry and (b) share findings that are generalizeable to a more broadscale creation and adoption of web-based study environments as a means to educational reform.

Web de Anza: An Example

Web de Anza is a multicultural, bilingual website (http://anza.uoregon.edu) dedicated to providing teachers, students and scholars with an organized online collection of information about Juan Bautista de Anza and his two 18th century overland expeditions from northern Sonora to *Alta California*; expeditions that led to the founding of San Francisco and the settlement of California. The first expedition (in 1774) opened an overland supply route from Mexico to the missions and presidios being developed by New Spain along the California coast. The second expedition (1775-76) brought 240 colonists (men, women and children) by horseback to the mission in Monterey, for the purpose of settling the San Francisco bay area. The first expedition has been compared to that of Lewis and Clark, while the second is somewhat analogous to later emigrant movement along the Oregon Trail.

The core of the website is an archive of primary source documents in both Spanish and English, presented in ways that are designed to support sustained exploration and foster historical inquiry. For example, there are a total of eight diaries pertaining to the two expeditions. All diaries are maintained in a database so they are served out as dynamic web pages as needed. For each diary there is a hyperlinked calendar, providing instant access to the diary entry for any given day. In addition, internal links between diaries allow the reader to toggle back and forth between the English and Spanish versions of a single diary or between multiple diary entries for the same date. In this way, a student can study the various perspectives of expedition diarists as they describe the events of a single day, or they can compare the English translation with the Spanish original.

Supporting the archive of original diaries, letters and maps are various types of hypermedia resources, designed to enhance the readers' comprehension and extend their learning. For example, resources such as definitions, explanations, pictures and even video are linked to words in the text that may be unfamiliar to the user. These types of resources can be used to provide students with information and pictures of 18th century articles (e.g., a saddle or uniform) or link the reader to information about a specific place, person or Indian tribe mentioned in the text. In addition, use of the website as a whole is supported by specially drawn maps, timelines, synopses, etc. Biographies are provided for key people, and the text of related secondary sources such as journal articles and chapters are provided for easy reference. Links to related websites help users extend their exploration and inquiry to other online sources.

The goal is to provide users of Web de Anza with the materials and supportive resources they need to investigate their own questions concerning this period in Spanish American history. By having access to primary source documents, students and teachers can draw their own conclusions about historical events, persons, and processes. Students are able to play historian, interpreting the data they find in the primary source documents and drawing conclusions as to their significance. This gives students a new understanding of what history is, what role historians play in interpreting history, and how they too can conduct authentic historical inquiry on topics of interest.

Topics for Web-Based Study Environments

Web-based study environments can be constructed for any purpose that requires sustained exploration of multiple documents. Because the Internet is used as the mechanism for distribution, students and teachers can be brought into contact with online collections of primary source material that would never otherwise be available to them. In addition, they can be provided with the embedded resources necessary to enrich their understanding and support their exploration. To assist teachers and students in the design and development of web-based study environments, we have created a list of criteria for selecting appropriate topics.

1. There should be a large quantity of primary source documents related to the topic that are either in the public domain or for which copyright permission can be obtained.

2. The primary topic should be appropriate for the school curriculum and suitable for integration into multiple disciplines or supportive of an interdisciplinary approach to instruction.

3. There should be an element of drama, mystery or intrigue surrounding the topic or events - something that can be used to motivate sustained study on the part of students.

4. There should be a lack of familiarity with the topic on the part of teachers as well as students, hence providing a platform to support authentic historical, literary or scientific inquiry.

5. There should be a high potential to expand inquiry into numerous related fields, requiring research outside the system and possibilities for bringing back new information to the system.

6. There are unanswered questions, thus providing an authentic need to think reflectively about the documents and an authentic possibility that students could pose novel solutions or contribute to the construction of new knowledge in the field.

8. There is a human element to the topic and/or events - something to bridge the gap across time and create empathy for the people involved.

9. There is a community of scholars/experts/collaborators willing to engage and affiliate with the project for the purpose of supporting and assisting teachers and students in their inquiry.

Integrating web-based study environments into the curriculum is an excellent way to foster school reform. They provide a vehicle for restructuring out-dated curriculum and an authentic way for teachers to engage students in real-world learning. They can be tied to state and national standards, and used to support authentic assessment of learning. And they encourage higher order thinking by promoting the active cognitive manipulation of information, a prerequisite for turning information into knowledge.

Making Peer Review in Large Undergraduate Courses an Option

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Abstract: In this paper we describe research in progress on web-based peer review of reports and essays. The research is a part of a larger research project on computer supported examination. We have developed an application for administrating peer review of essays and reports in large university courses. The application was evaluated in an undergraduate course with eighty students. This paper discusses our experiences, findings and further research.

1. Introduction

In university and other forms of higher education, different types of collaborative activities are slowly becoming the basic block of education. These collaborative activities are often building on the model of collaborativism. The basic premise in collaborativism is that learning emerges through shared understandings of more than one learner [Leidner and Jarvepaa 1995]. The goals of collaborativism are active participation and communication. Collaborativism assumes that the control of the learning should rest with the peer group, that learning is the sharing of knowledge among learners.

Peer review is one possible way to engage learners in collaborativism. The value of peer review is widely recognized. "Students are found to plan more extensively and write more carefully when they are communicating with an audience of peers than when they are being evaluated solely by the instructor" [Bagley and Hunter 1992]. Similarly, "It's worth emphasizing that it is not always necessary for academic staff to give feedback: students can often learn more from formal or informal assessment by their peers or by themselves" [Ramsden 1992].

Focusing on higher education practice, peer review in large classes is by default problematic as it creates an, in many ways, unbearable administrative burden on the educator coordinating the peer review process. Imagine administrating one hundred students writing papers and reviewing each other's within the current course budget. Networked environments can be a solution to overcome, at least, some of these problems. Peer review in an online environment has been suggested by for instance [Harasim et.al. 1995]. They suggest that students can work together in dyads or in small groups, using email or computer conferencing, for example for the first draft of their course paper. The instructor, they continue, provides a framework to guide peer critiques, and the grading assesses both the quality of the draft and the quality of the critique. We take these ideas a little further and suggest a web-based application for conducting peer review in large classes. In the reminder we describe the application, how it was evaluated, and finally we outline further research.

2. PeeR

PeeR (Peer review of Reports) is an application designed for publishing and reviewing short essays on the net. PeeR was designed and developed on a standard PC with Internet Information Server (IIS) and Microsoft Access. The functionality of PeeR is the following: (1) Reports or essays (2-4 pages) following the specific instructions are submit to PeeR. (2) The reports are published in PeeR where everybody participating in a course have access to read all other essays. (3) Each student is assigned one or more reports to review and PeeR also optionally email him or her of the result. (4) The students read, reflect and make constructive comments on their assigned reports and optionally on any of the other. (5) Reports and comments are stored in the PeeR database. (6) The teacher assesses both the report and the comments made. Grades are dependent equally on the report and on the quality of the comments. (7) The decision of when to close the posting (of reports and comments) may be preset in the application or changed at any time. (8) PeeR is web based and available regardless of time and place.

3. Evaluation

Students: We have previously surveyed 400 students about preferred form of examination. This research showed very diverse examination preferences among the students. However, when asked why they prefer a certain form of examination three categories of answers emerged after analyzing and coding their responses: (1) Learning (during examination), (2) Fairness, and (3) Convenience. In the PeeR research about 80 undergraduate students attended an introductory course in informatics. They were asked to write a short essay as examination at the end of the course. Thorough information about what was expected was provided in class and on the web - both instructions for the report but mainly for how to peer review. The aim was to have the students to view the report and the peer review as nonseparable entities of an examination. The three categories abovbe where then used in the evaluation of PeeR. A 1-6 (absolutely not – absoulutely) Likert scale were used and the distribution of the answers (n=61) were the following: First, if PeeR was perceived as learning, 25 gave it 1-3 and 36 gave it 4-6. Second, if PeeR was perceived as fair, 20 gave it 1-3 and 41 gave it 4-6. Third, if PeeR was perceived as convenient, 8 gave it 1-3 and 53 gave it 4-6.

Course Coordinator: *Report* - The open assignment invited the students to relatively freely structure their report. From a qualitative perspective most of the reports did not follow academic standards. More connection to the material covered in the course was however expected. *Peer review* - Apparently many students experienced difficulties in being constructive when commenting on their peers' writings. This was expected. However, very few destructive comments were made. Summarizing the report and the peer review we find that the student achievement overall must be considered as meeting the quality expected of second year business students.

Administrator/Developer: *Report* - Due to rather extensive online help and JavaScript validation, the need for active participation from the administrator was limited during this phase. It was more a question of providing information about the content of the essay. *Peer review* – The administrator played a more active part. The major reason to this was the use of cookies in PeeR and the fact that many of the students had disabled them in their browsers. In addition to this the campus computers, administered by the computer department at the university, didn't allow the students to accept any cookies. This was a matter of misconfiguration and easily solved.

5. Findings and Further Research

Our main findings from the evaluation of PeeR can be summarized as follows: (a) The survey of the students showed, as we interpret it, that our use of PeeR was successful. The participating students found PeeR to support learning in addition to being a fair and convenient form of examination. All in line with the findings in our previous research. (b) From the perspective of the course coordinator peer review was a new form of examination to most of the students. However, by a more thorough discussion with the students about the purpose of peer review as examination, as well as more structured instructions and guidelines, PeeR is believed to be a viable complement to other forms of examination in large undergraduate courses. (c) We also claim that peer review is possible to administrate even when the number of students is substantial. The next steps of PeeR are: (1) To design and develop the full application with an administrative interface. (2) To increase the number of settings controlled by the administrator. (3) An option to convert essays to portable document format (pdf), to enable PeeR to email documents to reviewers. (4) Have the comments instantly mailed to the authors.

6. References

[Bagley and Hunter 1992] Bagley, C and Hunter, B. (1992). "Restructuring, Constructivism, and Technology: Forging a New Relationship". Educational Technology, July, pp. 22-27.

[Leidner and Jarvepaa 1995] Leidner, D. E. and Jarvenpaa, S. L. (1995). "The Use of Information Technology to Enhance Management School Education: A theoretical View." MIS Quarterly 19 (3): pp. 265-291.

[Ramsden 1992] Ramsden, P. (1992). Learning to Teach in Higher Education. London, Routledge.

[Harasim et.al. 1995] Harasim, L., Hiltz, R., Teles, L.and Turoff, M. (1995). Learning Networks – A Field Guide to Teaching and Learning Online. Cambridge, The MIT Press.

Java Applet for Pharmacokinetic Simulations

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Abstract: The web-based vizualization tool, PharKinS, simulates multiple drug concentration/time profiles in blood and tissues for most real-life situations. The system responds to the user's selection of the input route and the rate of plasma/tissue equilibration with a depiction of the corresponding compartment system and an indication which rate parameters to specify. This specification and a dosage regimen (up to three consequent single, repeated or continuous doses) represent the input for the simulation. Up to six different scenarios can be plotted simultaneously and compared. The applet is suitable for teaching pharmacokinetics and similar disciplines.

1. Introduction

Pharmacokinetic models serve for prediction of the fate of drugs and other biologically active compounds (e.g. toxicants, conserving agents, food additives, all referred to as drugs for brevity) in biosystems and, more specifically, for optimization of drug dosage regimens. The models are frequently simplified using the compartmentalization of biosystems that leads to the use of sets of linear differential equations for description of the concentration/time profiles. Sometimes the solutions to the sets of equations can be obtained in analytical form.

Teaching of pharmacokinetics conventionally relies on the use of the analytical concentration/time profiles. The profiles are useful for delineation of basic relationships between individual pharmacokinetic parameters and for illustration of the influence of the parameters on the shape of concentration/time profiles. There are situations, however, when the use of analytical concentration/time profiles is not sufficient. The situations include (1) more complex drug/biosystem interactions that cannot be described analytically even after compartmental simplification (e.g. presence of several compartments and/or nonlinear processes) and (2) parallel or serial combination of several simple events with analytical description (e.g. multiple dosage regimens, dosage regimens including more than one route of drug administration). A visualization tool for quick and convenient generation of concentration/time profiles is required to provide students with basic understanding of the concentration/time profiles in the more complicated situations and to allow them to study the influence of the model parameters on the shape of the profiles.

2. Approach

A cheap, easily accessible and upgradeable vizualization tool, PharKinS (*Phar*macoki*n*etic *S*imulator), was constructed using the Java applet technology. The simulation is run using numeric integration of the corresponding differential equations and therefore it is not limited to the situations for which analytical solutions to the set of underlying differential equations exist.

2.1 Applet Description

The applet window is divided into five areas. The largest section is occupied by the plotting area for the concentration/time profiles. The rest of space is used for five blocks. Three blocks (Model Selection, Model Parameters, and Dosage Regimen) serve for input needed to run the simulation. The fourth block, Compartment Scheme, is used for graphic representation of the model that is created using the input information. The fifth block, Plot Control, color-codes up to six different scenarios for which the concentration/time profiles can be compared. The following description of a typical simulation outlines the function of individual blocks.

2.2 Applet Function

2.2.1 Model Selection

The user starts the simulation by selecting the model corresponding to the respective drug/biosystem interaction in the Model Selection block. The choices currently include intravascular/extravascular route of administration and fast/slow distribution from plasma to tissues. The fast/slow release from the dosage form is being considered. The selection in this block will determine the number of compartments characterizing the system: one central compartment for intravascular administration and fast distribution; addition of the dosage form compartment for slow release from the dosage form; addition of the dosing compartment for extravascular administration; and addition of the tissue compartment for slow distribution. In summary, the biosystem can be represented by one to four compartments depending upon the complexity of the drug/biosystem interaction.

2.2.2 Parameter Input

Specification of the model in the Model Selection block results in automatic adjustment of the Model Parameters block and in the Compartment Scheme block. The values of the model parameters (the rate constants of individual processes and the volumes of compartments) need to be entered in the input windows in the Model Parameters block. To guide the user, only the input windows for the required parameters are accessible and contain reasonable default values. The model parameter being entered is highlighted in the Compartment Scheme block until the cursor is in its input window.

2.2.3 Dosage Regimen Input

The Dosage Regimen block allows for combination of three different dosings: single dose, repeated dose (dose and dosing interval), and continuous dose (dosing rate and duration). The waiting times between individual dosings can also be specified. The block consists of three lines starting with menus specifying the dosing. The input windows following the menu are adjusted according to the selected dosing and contain reasonable default values. This layout provides for creation of variety of different scenarios. They include many practical situations, e.g., the intravenous infusion or repeated oral dosing preceded by a loading dose, intravenous infusion followed by repeated oral dosing, or a change in the dose or dosing interval of the repeated oral dosing regimen.

2.2.4 Comparing Different Scenarios

The Plot Control block contains, in addition to basic commands like Plot or Delete, a device for comparing different scenarios. Up to six color-coded concentration/time profiles can be plotted simultaneously. The device allows for review/change of parameters of individual simulations: when a color is selected, the Model Parameter block and the Compartment Scheme block adjust to show the corresponding data that can be modified. Color-coding is also used to connect the compartment in the scheme with its respective concentration/time profile.

3. Summary

PharKins is a free, versatile yet sufficiently simple tool for the use in the classroom for teaching Pharmacokinetics or related disciplines and for homework assignments. The use in pharmacy practice to compare concentration/time profiles for different scenarios requires further testing and validation. A current version can be previewed using the link at www.ndsu.nodak.edu/instruct/balaz/teaching/phkin470/frame.htm.

Acknowledgement

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Facilitating Learning in the Virtual Classroom

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Abstract: The integration of technology for educational purposes provides teacher education institutions with powerful tools not only for the delivery of courses to geographically distant students but also for enhancing classroom learning. Online education should not be understood as the downloading of information followed by the passive and solitary activity of staring at a computer screen. Instead, online education advances the pedagogical principles of constructive learning through providing opportunities for constructive sociocultural interaction.

Teaching Philosophy for the Virtual Classroom

The integration of technology for educational purposes provides teacher education institutions with powerful tools not only for the delivery of courses to geographically distant students but also for enhancing classroom learning. Online education should not be understood as the downloading of information followed by the passive and solitary activity of staring at a computer screen. Online education promises superior results because: (a) students actively construct knowledge by exploring web sites, experimenting with search engines or new ways of seeking information, manipulating things, and engaging in discussion; (b) students are able to explore other learning styles and find out what works best for their cognitive abilities; (c) students work not only with the teacher but also among themselves which leads to additional learning; (d) students improve their critical thinking skills by examining ideas found on the world wide web and using the entire class time for critical analysis of a topic rather than information delivery; (e) students gain better understanding of a topic by searching for more web sites and exploring different perspectives of a subject; and (f) students learn how to learn [Bazillion & Braun, 1998]. To make the online classroom successful, learners need to have meaningful and constructive sociocultural interaction.

Sociocultural Interaction

The most dramatic difference between online classes and traditional face-to-face classes is how students will participate in discussions with their professors and peers. Fundamental to computer mediated communication is the concept of being able to use technology to simulate the human communication process. Online communication tools develop and improve almost daily; for example, text-based environments are evolving into graphical and even multimedia environments. The most common tools that can be used for online collaboration are e-mail/World Wide Web, synchronous and asynchronous communication. Instead of leading a typical discussion in a classroom with his/her students, the faculty member now serves as a discussion moderator who helps students understand the material from lectures and readings.

E-mail and the World Wide Web

E-mail and the World Wide Web are used for the transfer of information, either privately through e-mail or publicly through a web page. To a certain extent, these tools provide students the opportunity to solve a problem, to learn from each other by sharing the problem-solving process, and to gain experience in teamwork. The main advantage of this method is that messages, such as papers, personal thoughts, pictures, software programs, etc. can be transferred any time as well as read anytime. This information exchange happens almost instantaneously and is certainly faster than regular mail. However, if e-mail and the World Wide Web would be the only communication tools, constructive sociocultural interaction in an online class would be almost impossible or, if at all, only be possible with very few participants. E-mails could easily get lost among other e-mails irrelevant to the online class or they are misunderstood and misinterpreted because of the out of context delivery of messages.

Synchronous Communication

Synchronous communication is real-time communication, often referred to as chat, meaning that participants are online at the same time and messages are transferred immediately among all the students. Many synchronous communications are primarily text-based. Probably the most important function of synchronous communication for facilitating collaboration is the opportunity of students to brainstorm, sometimes even supported by a whiteboard on which every student can write, draw, or demonstrate a concept. Synchronous communication is helpful for decision making purposes, such as voting on a topic, splitting up group work, assigning specific tasks, etc. because it enables participants to make decisions immediately instead of waiting for responses sent by e-mail. Also, synchronous conversations seem to promote a feeling of belonging and to decrease isolation of group members. Synchronous communication, however, tends to become chaotic easily. Even where the communication is in real-time, there is still a short time-delay caused by students' typing speed. By the time a student finishes typing a response to another student's message, several other messages might have been posted already and the discussion might have moved into a different direction already. Anecdotal evidence suggests that collaboration through a synchronous communication is only possible in a one-on-one situation or probably small groups of up to four students.

Asynchronous Communication

Asynchronous communication is the most common tool used. To realize the advantages of asynchronous communication, one might compare it to face-to-face conversations: some students process the presented information immediately and respond with interesting and valuable comments; other students might have interesting comments but not right away; and some students talk all the time without having anything to say. Asynchronous conversation allows every single student to participate in the class discussion without being forced to respond immediately, without being interrupted by another student, and without being cut off by the sound of the school bell. Students and instructors have time to think before speaking/responding to the class discussion and also do not have to wait for the next class to express their views. And they can do all of this when they are personally in "top form" instead of during scheduled classroom face-to-face hours. As appealing as asynchronous communication might sound, potential problems need to be known in order to counteract them before they turn into real problems. Since asynchronous conversations allow every student to say/write what they want, students could easily get off the topic or even become insulting to others. Thus, the rules for asynchronous communication need to be clear to all participants, just like rules in the traditional classroom need to be clear to the students too, for example no harassment or rudeness will be tolerated and mutual respect is obligatory. Furthermore, the communication needs to be very organized and structured so students do not get off the topic or "get lost" in the conversations. Every computer mediated communication tool should provide students with an outlet for discussions outside of the range of topics just as a student lounge or student center provides.

Conclusion

All of the above mentioned methods of virtual sociocultural interaction have in common that they are neither limited by time nor place. Students from different cultures and/or different nations could discuss their thoughts and ideas and utilize a variety of resources from many more places, for example, in an environmental project where students from the northern end and the southern end of the Rhein river (Germany and Switzerland) take water samples to determine the river's pollution level and the countries environmental policy to avoid pollution. The three methods also have in common the potential for misinterpretations because of the lack of physical cues, such as gestures or body language, which is part of communication in face-to-face situations. Attempts to express body language, mood, and gestures by using so-called emoticons have had doubtable success. Aside from the suggested limitations, first experiences with online courses show that asynchronous conversations produce the most constructive sociocultural interaction.

References

Bazillion, R.J., & Braun, C. (1998). Teaching on the web and in the studio classroom. *Syllabus* 11 (8), pp. 37-38. Available: http://www.syllabus.com

Opera - A Student Experience in New Media

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Abstract

New Media has been widely used to deliver course content to students, either over the internet, on CD-ROM or in hybrid CD-ROM/Web format. Yet, little work has been done that is helping students use New Media technologies to create content as a part of their learning experience.

The class in this study consisted of 18 students in the Visual and Performing Arts Programme. Very few had previous exposure to computers beyond the standard word processing. The professor teaching the course was not a computer savvy person, but was willing to experiment with New Media, adjust the lecture style and change her evaluation methods. From the onset of the course it was planned to include a media specialist who would provide all the technical support and train students on the use of the New Media.

Why Opera and why New Media?

Although not a very popular subject in itself, opera has great potential for study and analyses using New Media technology. Surprisingly, there are few commercially available productions that use and explore New Media technology. At present only Wagner's "Ring Cycle" is available. In this course, Rossini's "Barber of Seville" was chosen for the New Media project and Verdi's "La Traviata" was used for traditional teaching and evaluation methods.

Faculty Perspective

Prof C.Clarke, who was teaching the course, found that students do appeared to engage in the potential of the medium. In particular, digitized sound provided good opportunities for dissecting musical lines, voices and instruments. Linking audio with textual discussion of the libretto, dramatic action, characterization and instrumentation illustrated the dramatic potential of the medium far better than was possible in a traditional linear analytical essay. As well, students provided more astute observations in their musical analyses and in their discussions of all the parameters of operatic production. Aspects of opera that were discussed included staging, scenery, costumes, voice types and singing styles, as well as plot development. Most importantly, because the nature of the medium forced the students to operate in sound through time, they seemed to experience the "performative" elements central to the operatic genre. They acted as "operatic designers" when creating their websites. In addition, by conducting research outside the traditional arena of biographies, operatic histories and print sources, students were able to incorporate other related materials. This exercise was seen as a great benefit to the student learning process. This process of using New Media, allowed several of the participants, with apparent disadvantages to contribute to the project in unusual ways; "There were several students, who I knew from past courses, that I didn't expect to do very well" observed Prof.Clarke. In another observation, she notes: "The students were actually teaching me in the way they presented the material. They astounded me with new ideas, states of mind and psychological development rarely seen in conventional student presentations and writings".

Student Perspective

From their immediate feedback students spent more time working on the assigned projects than they would normally spend on an essay type assignment. They appreciated the new skills they developed working with New Media, and derived a greater sense of satisfaction from their collaborative work since they were able to reach a much larger audience than a single professor or grading assistant. Some of the quotes from students obtained at the end of the term:

> "A Web/CD-ROM project is a fun way to approach a course or area of study that has a lot of visual and audio information.....";
> "The technical aspects of the project itself, was for many, a new and worthwhile learning experience...";
> "Appart from the new technology itself, putting together Web/CD-ROM helped me to link research, musical excerpts and score together in a way I might not have done in a formal essay...";
> "educational value also existed in the fact that during the development and once it was complete we could see how one's contribution related to the project as a whole...";
> "we were encouraged to explore the WWW to incorporate various link with our own site and this enabled us to think how our web site fits into rest of the world...".

All students agreed that in spite of more hours spent on the project, it was worthwhile for them to learn New Media technology, problems associated with use and design of the Web/CD ROM and clearly the benefits and pitfalls of collaborative projects. Since their comments came after they received their final mark for the project, it was surprising that there were no major negative comments.

Conclusion

Since this was not planned study, no formative design and evaluation was conducted. We viewed it as a "just-in-time" or exploratory project that would help us to identify some of the underlying issues that are important in teaching a rich media course. The technology was not the focus and the classical goals of a traditional course were observed:

1. Knowledge of the subject area
2. Ability to analyze and make deductions
3. Clarity and relevance of expressing the above.

However, in addition to these, students learned to work with various media by using Adobe Photoshop 5.0, Macromedia SoundEdit 2, Macromedia Dreamveawer 2.0, Netscape 4.4, and a flatbed scanner. In the process, they learned some concepts of media quality, delivery and hypertext design.The project was placed on a secure web site due to the copyright issues with various media. At the conclusion of the project, each student received a CD ROM version of the project.

To conclude our observations, it is possible to launch this kind of course assuming that the class is small, you have an appropriate facility, faculty that is willing to experiment and intensive technical support available to the students. In the end, it has been a rewarding experience for students, faculty and the technical staff.

Acknowledgements

I would like to extend my deep appreciation to Prof.Caryl Clarke for her willingness to enter "uncharted waters" and allow the experimentation to take place. She also contributed with her observations and analyses of the whole process.

Of course, my appreciation extends to all 18 students in VPAC80 course, who were more than enthusiastic about the whole project with many long hours spent in the multimedia lab.

Integrating Web-Based Learning Into The University Curriculum

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Abstract: This paper will outline the pedagogical and organisational methodologies arrived at in the process developing web-based courses and resources in the context of the digital campus initiative. The major issues addressed are (1) how web-based instruction can raise rather than lower the quality of pedagogy and learning, (2) how web-based learning has been integrated into classroom-based courses when the students do not have access to computers in the classroom, and (3) how the use of human and technical resources are being maximised to deliver web-based learning within a complex curricular framework. In discussing these issues, we will draw on the experience of the English for Professional Communication web <http://ec.hku.hk/epc/>

1. Raising the Quality Of Pedagogy and Learning Through the Web

A typical early response to the demands of integrating IT into the curriculum is for academics to place their lecture notes or course materials on the web. It is questionable, however, whether this leads to any real development in IT literacy beyond the ability to browse a web site, or whether it represents any pedagogical advance over paper handout and overhead transparencies.

A second early response is include review and testing features within course web-sites in the form of on-line quizzes and feedback. Although technically feasible using web-based learning packages, it is again questionable whether any real advance in IT literacy or pedagogy results. In particular, the technological constraints on question and answer routines over the web (largely limited to true-false and multiple-choice quizzes) may well lower the quality of pedagogy when the subject matter calls for complex and fine-grained evaluation of student responses. In the context of language learning, in particular, the use of web-based technologies for teaching input and testing is often based on simplistic or retrograde methodologies. The rich communicative interaction inside and outside the classroom that is at the core of many current language teaching approaches has so far proved difficult to replicate on the web.

In sum, there is a genuine risk of actually lowering the quality of pedagogy and learning when web-based materials are integrated into a course. This appears to be particularly the case when the effect of IT integration is to convert a classroom-based course into a quasi-distance course. In language learning, as well as in other areas of the curriculum, the loss of the benefits of classroom interaction is unlikely to be outweighed by enhanced access to materials. In the light of these concerns, one the driving forces behind our development of English language learning resources has been to examine how to enhance pedagogy and learning. Among the key elements of the approach we have taken are the resource centre model, the exploratory learning model and authenticity of interaction.

The *resource centre model* implies that a web-site developed to fit in with a particular course should not necessarily attempt to replicate the content of the course, but rather function as resource for learning. This model corresponds to an approach to pedagogy which that emphasises the learner's construction of knowledge through interaction with a rich bank of resources. While users are able to find content and tasks used within the classroom in the web-based resource centre, these are not necessarily presented to them sequentially and they are likely to find considerably more than can be covered in the classroom.

The English for Professional Communication web, which focuses on job-seeking skills is, organised into seven modules. Within each module, there are pages covering general advice on the topic (with each key point accompanied by an online task to develop language and reinforce meaning), models and links to additional resources on the web and within the university. As a matter of principle, we have adopted a policy of moving from the more simple to the more complex, so that drilling down into the web through hyperlinks leads the learner to an increasingly rich range of resources.

The *exploratory learning model* implies that learning is not confined to content delivered in the classroom, but rather begins in the classroom and continues through a process of web-based exploration. This model is supported by providing a broader range of resources on the web than can possibly be covered in the classroom and by a problem-solving approach to course work. Faced with a specific problem such as writing a resume, the student receives some instruction in the classroom but the final quality of the resume is determined in part by the extent to which she explores the resources available on the EPC web.

BEST COPY AVAILABLE

Authenticity of interaction implies that use of the web and interaction with web-based learning tasks leads to real world outcomes for the student. By the nature of its subject matter, the EPC web is oriented towards the real world outcome of exploring possible careers and getting a job. Within the modules of the web, interactive tasks are also designed to give the learner usable linguistic output which can serve as a basis for discussion with teachers and careers advisors.

2. Integrating Web-Based and Classroom Learning

A typical initial response to the idea of integrating IT skills into the curriculum at our university was the idea that lecturers and students would be using their computers in the classroom. This has proved impracticable both because students have tended not to bring their computers on to the campus and because computer projection and network facilities are currently limited, especially in smaller classrooms typically used for language classes. It is not clear, however, that use of computers in the classroom is either necessary or desirable from a pedagogical viewpoint. While there are undoubtedly advantages to being able to demonstrate a web-site and how it works in the initial stages of a course, there is no reason to suppose that the loss of face-to-face interaction implied by extended use of computers in the classroom carries benefits for teaching and learning.

The model of integration adopted is essentially one where classroom instruction is supplemented by web-based work carried out between classes. However, in initial experiments with this model, however, it was found that students were inclined to view web-based work as 'extra work' not essential to the completion of the course. In the model represented by the EPC web, this has been addressed in two ways.

First, a teaching approach has evolved in which classroom learning incorporates materials from the web-site and is intentionally left 'incomplete'. This is supported by the inclusion of a 'downloads' page in each module of the EPC web, from which teachers are able to download and print Word and PDF versions of interactive tasks for use in the classroom. Learners are made aware that the materials they are using in class are a selection from a richer range of resources available on the web, and thus that what happens in the class is not the sum total of their learning.

Second, an approach has evolved in which learners are rewarded for use of the web in the form of improved quality of task outcomes. In classes on resume writing, for example, it has become clear that students who have made use of the web produce better resumes for themselves than those who don't. In follow-up classes this is pointed out so that students are made aware of the practical value of web-based research to enhance their effective use of IT tools.

3. Curriculum Organisation

In a small department required to teach a complex range of courses, it was clear that a model needed to be developed for effective allocation of human and technical resources. This model equally has implications for the organisation and structure of web-sites provided by the department. It appeared evident that the department would need a core of specialised staff to work on major web projects and staff development. Initially funded by the university, this core seeks to extend its life span through competitive bids for consultancies and development grants. At the same time, it was evident that all the teaching staff of the department needed to be involved to some degree in the development of web-based resources if these were to become the major teaching resource of the department.

The model for web-site development adopted is illustrated by the relationship between the EPC site and one course site that makes use of it. The EPC web, which is designed to serve a number of courses, is essentially a showcase web designed to be technically sophisticated and embody high production values. Its development has been dependent on the expertise of the core of specialised staff, but a process has also evolved whereby the content of the web, and particularly the conversion of text-based tasks to online interactive tasks, is dependent on negotiation with teachers whose expertise is more pedagogical than technical. The course web, which is less sophisticated from a technical point of view draws its pedagogical content from links to the EPC web.

4. Conclusion

As pressure mounts on educators to integrate IT into the curriculum there is a danger that sound pedagogy will fall victim to technological and budgetary limitations. By focusing on learning objectives the creators of the EPC have developed pedagogical and organisational methodologies that allow learners to access resource webs that foster an exploratory learning experience and authentic interaction.

Queuing Model for Performance Analysis of a Web Server

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Abstract: The World-Wide-Web has become synonymous with a mega warehouse of information. Of the many problems reported in using the Web, waiting for availability of Web sites seems to be the most common. In this research a queuing theory based model is proposed for studying the waiting time for accesses to Web sites in terms of arrival rate, service rate and number of connection ports. This analysis will be helpful in predicting load and accessibility of Web sites.

Introduction :

The World-Wide-Web has helped in the sharing of information between Internet users throughout the world. Though it was initially started as a project for enabling easy exchange of information between researchers who were geographically distant from each other [Berners-Lee et al. 1994], it has now taken the role of an international information superhighway. However, in spite of the apparent simplicity of use the users have reported several problems in the use of the Web. Among the top three problems reported in a survey [Lightner et al. 1996] are searching for specific information, speed of data access and locating and navigating sites. Inability to retrieve documents during an active search procedure has been a growing cause of user unsatisfaction with the Web. In most cases, users wait a significant amount of time and are then refused connection. This is largely due to the fact that information on availability of sites is difficult to obtain as it depends on a number of factors. In this research we propose a queuing theory based methodology that allows the users to get an estimate of the load on specific Web servers which in turn gives an idea of whether the users will be able to connect to the requested Web server when requesting for connection.

Principle of Operation :

The basic mechanism of operation of the Web is the same as that of a client server system [Bhargava and Sridhar 1997]. The three main components are a client site that requests for specific information, a Web server and a network connection that allows communication between the client and the server. The underlying network may be a corporate intranet or it can be the Internet itself. In case of the client server model based on the Internet the problem of communication is extremely complex as it involves a large variety of client sites (some client sites are Web sites) that request the server for information. The delay experienced by the user when requesting for information is a function of the client, the server and the network. In most cases, the site provider has no control over the network or the client sites. Keeping that in mind we only look at the server side of the scenario in this research. The delay of the server can be attributed to a number of reasons that include current load on the network, the available memory and also the speed of the processor. Among these the load on the network is usually a variable quantity and has a crucial role to play in allowing users to connect to the Web sites. If the load on the network can be estimated with a certain degree of accuracy then we can provide the client sites an estimate of whether they will be able to connect and also how much time they would have to wait before the connection is established.

Queuing Analogy :

Using a queuing theory based approach the Web servers can be modeled as a finite capacity queuing system. The queuing model that could be of use is an M/M/c/N model. The requests for connection arrive at the Web server and if there are ports available then the requests are satisfied and a collection of hypertext markup language (HTML) files and inlined multimedia files (i.e. image, audio and video files) that are embedded in the HTML files are sent to the requesting client sites. It is assumed that the requests can only be served if there are available ports on the Web server. If not, then the requests are lost from the system. If the client sites repeat the request process, then the recurring requests are treated as new arrivals to the Web server. In the terminology of queuing theory, the requests for connection can be looked upon as 'customers' and the downloading of Web pages can be treated as 'service to the customers'. The service is provided by the main and the multiple proxy Web servers. In an M/M/c/N queue, the arrival and the service processes are assumed to be Poisson. Since there is a finite capacity waiting room with capacity 'N', hence all customers are lost from the system if there are 'c+N' customers in the system. Closed form analytical expressions exist for the analysis M/M/c/N model [Tijms 1994]. Of particular interest are the expressions for the steady-state probability (which gives the the probability that there are 'j' customers in the system, the rejection probability (which gives the fraction of customers that are refused service because the waiting room is full), and the average utilization (which gives what percentage of servers are busy at any time and is a surrogate measure for the utilization of the servers), and also the average waiting time for a customer before start of service. The significance of these analytical expressions is that they can be used for a 'quick' calculation of the various parameters and can be broadcast to the users who are requesting connection to the server. Of most importance is the figure on average waiting time. Users are usually frustrated when they have to wait for a long time before getting a notice that the server is unavailable. With this queuing model, it is much easier to inform the customers when the requested server has a long waiting time. Once the users receive this information, they can decide for themselves whether to wait for the connection or to try at a later time.

Validation of Model :

In order to validate the proposed queuing models we take recourse to log-file analysis for collection of necessary service parameters and conduction of numerical experiments. Traditionally Web server and common graphical interface (CGI) log-file analysis is typically used by Web site administrators to keep track of who is accessing the Web sites, what documents are being downloaded, and how the users are navigating through the various hypertext links on the Web pages. As noted in recent literature, [Eschenfelder et al. 1997] there are various log files which might be used by the webmasters. These include Access log for obtaining the internet protocol (IP) number of the user, date and time of access and user action taken during the access period and Path analysis log for obtaining detailed information on the browsing pattern of the user. In order to validate the correctness of this model we have analyzed the log files of accesses made to the homepage for a university. The log file analysis is done over a period of five months and some summary statistics are obtained from this analysis. During a week the number of visits tend to peak around the middle of the week and is lowest on Saturday and during a day the visits are lowest during midnight and early morning and highest during the afternoon. The summary statistics is next used for validating the model by conducting various numerical experiments. In particular we look at the summary statistics for obtaining estimates of two different parameters for the experiments – these are the average arrival rate and the average service time. Log file summary statistics usually report visits/day. We convert them to visits/second to enforce consistency of dimensions in the arrival and service rates. The average service time is reported in terms of the average time spent by users per visit and is recorded in seconds. Some preliminary results include computation of average waiting time, probability of rejection and average utilization of servers for various arrival rates. It is observed that even at 49.5% utilization of the Web server the average delay is quite significant (i.e. 233 seconds). For the same utilization of the Web server the probability of rejection is observed to be 0.00913.

References :

Berners-Lee, T., Caillian, R., Luotonen, A., Nielsen, H. F., & Secret, A. (1994). The World-Wide Web. *Communications of the ACM* 37 (8), 77-82.
Bhargava, H. K., & Sridhar, S. (1996). Design Issues in Configuring Servers on the World Wide Web. *Proceedings of the First INFORMS Conference on Information Systems and Technology*, Washington, D.C., 204-208.
Eschenfelder, K., Wyman, S. K., Bertot, J. C., Moen, W. E., & McClure, C. R. (1997). Using Log Files to Assess Web-enabled Information Systems Usage. *Proceedings of the Third Americas Conference on Information Systems*, Indianapolis, IN. 869-871.
Lightner, N. J., Bose, I., & Salvendy, G. (1996). What is wrong with the World-Wide-Web?: a diagnosis of some problems and prescription of some remedies. *Ergonomics* 39 (8), 995-1004.
Tijms, H. (1997). *Stochastic models: an algorithmic approach*. John Wiley & Sons, New York.

A Web-enabled Communication Environment for the Education Community

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Abstract: The research and development of computer-based, networked learning environments will be built around electronic communication and collaboration services that will play a significant role in the improvement of the learning procedure. Applications of this kind provide tutors and trainees with the ability of continual, close and efficient cooperation, en masse as well as individually. The goal of this work is the presentation of a communication environment that was developed in the framework of Odysseas project. The flexible design and implementation of basic communication services, accompanied with a friendly user interface, comprise an ergonomic environment and ensure the introduction of information technology in education as a daily communication and collaboration tool.

Introduction

Most developed countries endeavor in introducing network technologies and network software into education. Modern educational networks support a set of general-purpose elementary network services that provide some essential communication facilities to the end users. These facilities include collaboration, navigation into information resources, as well as interpersonal communication among the members of the education community. A recent project of this nature is Odysseas [Bouras 1997]. Project Odysseas (Integrated Network of School and Educational Regeneration in Achaia, Thrace and the Aegean islands) started in 1996, under the guidance of the Greek Ministry of National Education and Religious Affairs (YPEPTH). ("Odysseas" is "Odysseus", the Greek mythical hero.). The goal of this project is the design, development and pilot operation of an integrated network of 60 school laboratories located in three remote Greek geographical areas, Achaia, Thrace and Aegean islands. According to a research that took place in Greek education community, basic network services, such as email, discussion groups and bulletin board [Bouras 1996] are regarded as substantial components of a communication process. The basic network services that have been implemented in the framework of Odysseas, are the email service, the bulletin board service, the discussion groups service and the directory system. Altogether, they comprise a sufficient solution for interpersonal communication that will satisfy the goals of synchronous learning theories and methods, result in the improvement of the provided education and familiarize students with information technology. A Web browser was chosen as the interface platform for the basic network services. WWW-based tools are easily accessible through a URL. This contributes to the integration of the educational working space in terms of a Web browser.

Design Issues

The major design principles for our environment were obtained as a consequence of the needs expressed by end users and experts in a project like Odysseas, which aims at the introduction and exploitation of network communication services in education community. The present environment is designed in a hierarchical, two-level structure, the *school level* and the *regional level*. The communicational needs of users of the same school are served on a school level basis, whereas the communication between users that belong to different schools is dispatched on a regional level basis. This way, the applications are fully operational within the school environment, even if the communication link between the school' s NT Server and it' s corresponding main access point (regional level) is not available. The email service interacts only with the school's email server and therefore it is implemented on a school level basis. The bulletin board and discussion groups are implemented on a two-level basis: the bulletin boards and discussion groups concerning all Odysseas' users are stored in a remote

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level, whereas those concerning the users of one school are kept in local level (here, the NT Server.) The directory service is a complementary application that operates as a directory system for the three basic services. It provides searching operations through white/ yellow pages and it is designed in a two-level fashion. This application may be used independently, but it is also launched by the other three applications, where a searching operation among Odysseas' users is available.

Functional overview and scenarios

Project designers took into consideration all the existing technologies in order to invent new ways of evolving basic services environment into a learning tool. It was also taken into account that emphasis should be given on the pedagogical value of these services and not on the unproductive incorporation of the available technologies. Following this rule, the basic services applications were designed and implemented according to the international standards. They offer all elementary and advanced features, presented in a way that would reduce the users' cognitive overload. Special features are also available, that would contribute to the better understanding of the communication procedure.

Implementation Issues

Most innovative Web technologies are used for the retrieval and storage of information. Particularly, activeX platform, vbscript and cgi scripts are used to overcome the disadvantage of WWW passive protocol, HTTP. ActiveX platform is based on the tested COM Windows technology. It provides a wide range of effective, easily adopted features and tools, such as activeX controls, which contribute to the deployment of a fancy user interface. A wide variety of activeX controls-clients of several network protocols are also available. SMTP and POP3 clients of email and discussion groups applications are substantially based on a SMTP and a POP3 activeX control. ActiveX components co-operate harmoniously with other WINDOWS applications. The only restriction is that taking advantage of activeX technology requires the use of Microsoft Internet Explorer 4 as a Web browser. For storage and retrieval of information both *local access* and *Web access* is used (Figure 4). Local access is used in the school-level for reading/ modification of user's personal information, such as the user's profile or the personal email messages. Web access is used in the school and regional level for reading or modification of shared information, such as the bulletin board announcements.

Graphical User Interface

The environment has been designed, so as to provide a great degree of flexibility, without causing navigational difficulties and cognitive overload for users. The gradual presentation of the complete set of potentials for each application is achieved through the provision of several scenarios, that is different versions of the applications. In this way, the user will familiarize with substantial functions, using the easiest scenario, and gradually get acquainted with all the functions provided, using the most elegant scenario. Consequently, users enjoy a feeling of immediate confidence in their ability to master their new applications.

References

[Adam 1993] Adam, J. (1993). Interactive Multimedia: Special Report. *IEEE Spectrum*, pp. 21-39.

[Borko 1996] Borko, F. (1996). *Multimedia Tools and Applications. Florida Atlantic University, Kluwer Academic Publishers.*

[Bouras 1996] Bouras, C., Kapoulas, V., Kastis, N., & Spirakis, P. (1996). TRENDS: Training Educators through Networks and Distributed Systems. *EDEN Conference*, 8-10 July 1996, Futuroscope Poitiers, France, pp. 195-199.

[Bouras 1997] Bouras, C., Hadzilakos, A., Koutlis, M., Panopoulos, N., & Spirakis, P. (1997). ODYSSEAS: The Greek Educational Network for Secondary Education. *EUROAMERITEL '97 Conference*, 5-7 November 1997, San Jose, Costa Rica

Conversational Video Interaction

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Abstract: The aspects of conversational video interaction with sonic hyperlinks are discussed. As a [illegible] application sonic hyperlinks are integrated into an interactive application.

1 Motivation and Goals

The mainly used user interaction for the web is the hyperlink. When transferring the hypermedial interaction metaphor to a conversational human computer interaction scenario the audio channel is of great importance for a conversational interaction to video in respect to the dialog aspects of conversations. However, video hyperlinks like done with the Real Media Video System only annotate the graphic information of an audiovisual presentation. The information provided via the audio channel remains un-annotated. This lack of annotation for the audio channel is overcome by the use of an acoustic form of audio annotation, the sonic hyperlink as described by Braun [Braun et al.]. Without an acoustic annotation the audio channel can not be used as interactive information channel in a conversational way. (Hence, the user can not interact with the information he hears in an intuitive way). In the following paragraphs the use of sonic hyperlinks for the building of conversational interfaces for audiovisual presentations within the Web is shown. A authoring- and presentation prototype is presented, finally a evaluation scenario and first evaluation results are described.

2 Conversational Interaction System

The classic use of a computer is as tool controlled by humans to work on a task. This alters to the use of the computer as assistant who works for the human by delegation of tasks. In consequence the way the user interacts with the computer changes, altering from the use of commands given without the awareness of a context (direct manipulation) to a conversation with the computer in order to get information and to delegate work in relation on that information. The relevance of information in a context is defined as part of the Cooperative Principle, see [Grice]. A information exchange by conversation between two actors like a human and a computer has a couple of specific maxims, the maxims of relation, quality, quantity and manner

A conversation scenario with a fully enabled human conversation part needs a natural language processor to interpret the commands of the human within a context. The use of a natural language processor can be avoided by a simple context based interaction scenario with a given context on the possible commands of the human. The commands semantics differ in relation to the context. The hypermedia interaction metaphor is useful if one wants to create such a simple context based interaction scenario because of the known context that is annotated with hypermedia structures. This approach implicates a limitation of the human's conversation strength to a set of commands and the hypermedia interaction metaphor. In most cases conversational interfaces set the conversational strength to the user actions (i.e. natural language processing), ignoring the context information of the computer's reaction. But this conversational HCI scenario seem to be limited on the computer's part of the dialog too. A truly conversation scenario has two full enabled conversational parts of human and computer.

The benefit of a system that focuses on given context is the usability of content that was not created for conversational purposes, like the content of web-sites, traditional TV content or the content of multimedia presentations. For the impression of a conversation the user should be able to interact acoustic with the multimedia presentation by asking questions on the presentation's topics. If questions are accepted the acoustic topics are annotated by sonic hyperlinks. The user can activate the hyperlink by demanding more information via her voice. Of course the voice control can be stretched to other media too in order of multimodal input for a multimedia presentation. This leads to a conversational video interaction, based on sonic hyperlinks for acoustic conversational interfaces.

An acoustic hypermedia approach that supports conversational interaction to video has to constitute a sonic hyperlink and exhibit the requirements of a adequate sonic hyperlink conversation system. A sonic hyperlink is defined as a sonic hypermedia annotation of sonic information, see [Braun et al.].

3 Applications and Evaluation Scenario

As an impact of the upcoming change on user interfaces to assistant interfaces, many applications using audiovisual information have established them self in the past years. In the near future, the broadcasting of TV will grow into the WWW. Nowadays there are several well known media content providers that distribute audio-visual presentations through the WWW, e.g. the Encyclopædia Britannica Inc., the US TV station CNN. As image quality is not very high due to limited bandwidth, the focus of applications lies not in the movie sector but in the area of information supply (news services, business TV), entertainment (video clips), education (museum TV, product training) and marketing (advertisements, commercials, product presentations, promotion). Accordingly, the users of assistant systems stem from a widespread area and are especially interested in information access and presentation. This can be accomplished by using the sonic hyperlink methodologies as presented in [Braun et al.].
The evaluation of a system for conversational video interaction with sonic hyperlinks should allow (with the application scenario in mind) the test of the system acceptance and the performance increase for the user. The following test scenario is built: The user sits in front of a desktop computer using a microphone (head set), keyboard and mouse to interact with the test application. The test application shows a modular structure:
First level, low detailed information (via audio/video and text) is presented to the user. This level gives an audiovisual overview on information topics with the opportunity to access more detailed information. Second level, medium detailed information (via audio/video) is presented by user's demand; Third level, high detailed information (all kinds of media) is shown by user's order. Linkage of the levels: The Sonic hyperlinks (and others, like video hyperlinks and text hyperlinks) are used to connect the different levels of detail. The scenario can be controlled by commands via voice. Due to the use of hypermedia interaction, the user can step through the demo at the level of detail he chooses and thus as fast as he likes.
A first set of usability evaluations with a small number of 10 test candidates showed that although users are not familiar with sonic hyperlinks they quickly get used to them. In fact, users seem to prefer sonic hyperlinks if they have no previous knowledge about the topics given in level 1 of the test application. Primarily if the information topics are close related the user is able to speed up his search for information because of the context information access via video. A second test scenario with varying connection bandwidth showed that users seem to prefer sonic hyperlinks if both, video and acoustic hyperlinks are presented. It seems that with decreasing bandwidth the video quality is reduced by a higher amount than audio quality. This is because video servers have a higher priority for audio than for video as users tolerate low video quality rather than low audio quality.

4 Conclusion

First evaluations of conversational video interaction have been discussed. In order to strengthen the results we will enlarge our test series in the future. As a second aspect we will investigate in the area of ergonomic, like suitable sounds for sonic hyperlinks, other types of sonic information that are useful to annotate and further user reaction scenarios.

5 References

Braun, N., & R. Doerner (1998). Using Sonic Hyperlinks for Web-TV. *International Conference on Auditory Displays 1998*, International Community of Auditory Display.

Grice, H.P. (1975). Logic and Conversation, *Syntax and Semantics 3: Speech Acts*, New York, Academic Press.

How Community College Faculty Learn How to Teach Online Instruction

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Abstract:
This study examined the learning strategies of faculty and how they learned to use online course delivery as an instructional delivery strategy. The purpose of this study was to examine the learning strategies used by faculty in learning to use online course delivery. Research for this study reviewed the process of self-directed learning, the resources used by learners, the quality of both the process and the end product of learning, and the competencies of learners. Data was collected by conducting interviews with various North Carolina community college faculty who were currently teaching online courses delivery. The comments gathered were analyzed by means of applying the individual instructor's comments about learning to forms of learning as studied by Tough, Knowles, Mezirow, Marsick and Watkins, and Kolb. Emphasis for identifying learning processes looked at demographic characteristics, as well as reasons for participation. Data collected from the interviews also explored major ideas and concepts that influenced how the educators learned. Findings of the study identified incidental, informal, and experiential learning as prevalent means of learning for faculty. This study also identified faculty learning to use online course delivery as being unique to their learning with emphasis placed upon collaboration and cooperative learning among the participants. Participants in this study agreed that online course delivery as an instructional strategy was a means of reaching more nontraditional students, and they were proud to be considered pioneers in this field of learning and change.

In recent years the interest in online courses through the Internet for the delivery of higher education has increased considerably. This expanded interest is related to the challenges facing today's higher education institutions such as increased operating costs, reduced traditional student enrollments, reduced yearly course offerings to cut costs, reduced financial support for upgrades of computer equipment and software, and the reduced numbers of faculty in an effort to restrain rising costs. To overcome these hurdles, particularly at the community college level administrators are faced with the challenge of being able to identify the changing needs of the students and to meet these needs effectively and efficiently by including the increased use of technology.

With the Information Age upon us, research has shown that computer-based instruction has proven effective in post-secondary courses, addressing the student-centered learning and the self-paced, and individualizing study for adult learners. Adult educators have researched instructional strategies and how various classroom procedures help students to learn and understand information. The computer and the Internet have provided a means of a new vehicle for instruction and learning. Little is known yet about how instructors employ learning to adopt this new technology in the classroom.

The study reflected upon instructors who have been innovative and experimental in choosing to learn a new instructional strategy -- online course delivery. In conclusion of the findings of this study, faculty reflected a feeling of fulfillment through their teaching profession and the students. These faculty members were open to new ideas and experiences through their learning, and they examined their inner feelings and concerns about change and adapting to the technology associated with this change. The faculty in this study commented that the more they began to learn, the more they realized they did not know; therefore, they became self-directed in locating organized learning activities and opportunities to help them meet their learning needs. With new technology available, education is now more than just learning content and technical skills, faculty are learning how to learn and how to adapt and change.

At-Risk in Cyberspace:
Enhancing Engagement of High Risk Students in Internet-Based Courses

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Abstract: Concern has grown about the utility of technology based education for at-risk learners. This study explored effects of enhanced motivational and relationship building communications on at-risk students' engagement in an internet-based multimedia course. Patterns of engagement and moderate to strong effect sizes point to the need to systematically incorporate motivating dimensions into teacher-student communication.

Introduction

Many current designs for technology-based instruction presuppose learners with successful learning histories—learners who are at ease with written language, goal-oriented, intrinsically motivated, and self-regulated. Successful, goal-directed learners may represent only a minority of potential consumers of internet-based and other technology-based instruction, however. One especially neglected but important group are those learners who are at risk because of past school failure or other factors.

In many ways, technology-based education seems to be ideal for at-risk students. Instruction presumably can be shaped to meet almost any learner's needs and increasingly delivered to almost any location at any time. Many at-risk students, however, are likely to lack some key qualities needed for success in today's technology-based learning. These include high literacy levels, the ability to set goals, and holding a mastery view of learning (Dweck & Leggett, 1988). They may also not understand or chose not to exercise the conventions for communicating effectively in dialogic settings (e.g., Graesser & Person, 1994). Research is urgently needed to identify approaches that help at-risk students succeed in technology-based learning environments. Failure to identify such approaches can only widen the gulf between the "haves" and "have nots" in an increasingly technological society (Dede, 1998).

Background

This paper presents results of an experiment exploring factors affecting delivery of effective technology-based instruction to high-risk high school students. We previously had observed that students classified as at-risk and those not so classified responded very differently to internet-based courses, spending fewer hours working in the courses, having lower attendance, demonstrating more frustration, and achieving at a significantly lower level. Findings appeared to be independent of courses in which students were working. This experience led to the development of a series of studies focusing specifically on high-risk learners. The study described here examined the kinds of teacher-student communications likely to be most facilitative of at-risk students' learning and motivation.

Most technology-based courses involve live teachers who monitor student performance, provide guidance, and give feedback on student work. This study used both experimental and observation-based approaches in an internet-based multimedia course to identify effective relationship-building and motivation strategies that on-line teachers might profitably use in courses targeted at at-risk students. This research involved an experimental comparison of enhancements to a baseline professional condition in a 2 X 2 design: (1) lower and higher levels of personal investment in students (e.g., Bosworth, 1995; Noddings, 1995) and (2) lower and higher levels of motivation building (Bandura, 1997; Weiner, 1995). Student responses to teacher feedback were monitored by means of on-line response forms and direct observation and were further probed through focus groups.

Results

The internet teacher carried out interactions with the students with high fidelity to the treatment conditions, with reliability indices of .84 on the extent to which the motivation condition was implemented and of .90 on the extent to which the personal investment condition was implemented. Four variables measured different aspects of student engagement: ratings of student effort on e-mails, lab monitor ratings of engagement, hours worked in the course, and course grade (based on completed work). Effect sizes are reported for all variables. Results are presented in Table 1. For student effort on e-mail, effect size analysis showed a moderate effect for motivation-building ($\eta^2 = .06$) and a large effect for the motivation-building x personal investment interaction ($\eta^2 = .17$); in lab monitors' ratings of engagement, that motivation x personal investment interaction had large effect sizes ($\eta^2 = .26$ and $\eta^2 = .29$ respectively); and, in course grade, that motivation building ($\eta^2 = .13$), personal investment ($\eta^2 = .25$), and the personal investment x motivation-building investment ($\eta^2 = .13$) all had large effect sizes. Above and beyond effects for treatment, individual differences played a significant role in at-risk students' engagement. Writing ability and e-mail engagement were significantly correlated ($r = .47$, $p = .03$), while the relationship between writing and lab monitors' engagement rating approached significance ($r = .39$, $p = .07$), suggesting that teacher interactions are subject to the influence of individual differences

Table 1. Means and standards deviations by motivation and personal investment condition

Condition	Low Motivation		High Motivation	
	Low Personal Investment	High Personal Investment	Low Personal Investment	High Personal Investment
Effort				
M	1.52	2.07	2.23	1.88
SD	(.47)	(.47)	(.52)	(.79)
Engagement				
M	2.38	4.38	3.50	3.44
SD	(1.35)	(.43)	(1.02)	(.66)
Hours				
M	43.56	47.81	45.5	50.94
SD	(19.06)	(6.42)	(5.01)	(13.74)
Grade				
M	52.25	83	90.75	90.25
SD	(44.31)	(5.32)	(9.34)	(5.44)

References

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman.

Bosworth, K. (1995). Caring for others and being cared for: Students talk caring in school. Phi Delta Kappan, 76, 686-693

Dede, C. (1998, May). Distributed education: Future direction. Presentation to Star Schools Directors and Evaluators Meeting, Alexandria, VA.

Dweck, C., & Leggett, E. (1988). A social-cognitive appraoch to motivation and personality. Psychological Review, 95, 256-273.

Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. American Educational Research Journal, 31, 104-137.

Noddings, N. (1992). The challenge to care in school. New York: Teachers College Press.

Weiner, B. (1995). Judgments of responsibility: A foundation for a theory of social conduct. New York: Guilford.

Hypertext Editing in the Classroom

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Abstract
Literary works are the products of a dynamic process in which many factors may influence the changing content of the work. The study of literary change can impose stringent demands on students, even to the extent that many students are prevented from seriously entering this content area because of cognitive challenges. We report an interactive multimedia environment that has been developed to foster (1) student entry into the content area through an information format that we have coined "substitutional hypertext", (2) student experience of the process of scholarship in this field, and (3) emulation of the authoring experience in the style of the author being studied.

This suite of interactive programs for creating, exploring, and editing hypertexts demonstrates how multimedia learning environments can be crafted to open access to contents areas from which students would ordinarily be barred. Students, and even some literary scholars, assume a teleological view of literature, as if a work of literature could be represented as an idealized static entity toward which the author was striving. In reality, the development of a work of literature is dynamic process in which the authors' creative energies my undergo formative changes that reflect the authors changing attitudes and skills, interactions with collaborators, errors of transcription, and the influence of the author's perceived audience.

The learning system that we will illustrate here, the "Hypertext Explorer", elevates student experience of the content area in three ways:

i. *Providing access to a challenging content area.* Traditionally, changes in literary works are documented in editorial editions. In these texts, alternative variants of modified passages are represented in an index-like structure (the editorial apparatus) at the end of a version of the entire text. This process requires that students memorize variant passages from the editorial apparatus, then substitute them in their mind's eye when they return to the position of the passage in the entire text. This is a demanding task for professional scholars and usually represents an impenetrable barrier to the content area for novices.

This learning system introduces a hypertext tool that allows students to substitute passage variants simply by clicking on the passage. We refer to this interface device as "substitutional hypertext". Substitutional hypertext entries are "smart" hypertext links in the sense that they elicit context sensitive responses. For example, let's assume that a certain passage has been represented differently in two successive versions of a piece of literature. This entry could be displayed in the text three alternative ways. First, both passages may be represented side by side, circumscribed by delimiters that identify which version of the text each string represents. Clicking on this marked text will cause the entry to be replaced by just the string of just the first variant. Clicking again will result in the replacement of the first variant string with the modified string of the second variant. Clicking a third time cycles the string back to the two delimited variants of the passage. Substitutional hypertext eliminates the necessity of envisioning a text substitution in one's mind. Moreover, students can create text that never existed by creating a new text with variant combinations that were never published.

ii. *Providing experience in the process of scholarship.* We lament the fact that students too often experience a discipline as an outsider looking in, learning lists of facts without developing an appreciable skill in the methods of critical inquiry utilized in scholarship. The hypertext environment illustrated in Figure 18 not only offers students access to the content area through substitutional hypertext, it contains assessment tools that students to approach the text as a scholar would. When a variable passage is selected, the student must click one or more buttons that reflect the student's estimate of the authors motivation for that change, and the student must justify their decision in a brief essay in the "justify interpretation..." field. Thus the student is thrust into the role of a scholar, a task which was virtually impossible with traditional editorial editions.

iii. *Providing experience in editing/creating texts.* The variants in critical editions, which currently exist in inaccessible lists in appendices to print edition, actually contain the most important information for students-as-scholars to process. Separated in space and dependent on prodigious acts of memory, the variant lists in print resist a scholar's attempts to interpret and then create holistic structures. In our hypertext interface, however, the variants are not only available within the span of an eye but also open to (re)interpretation by the student-user. Once all the different variant "hotspots" in a certain text have been identified as belonging to one or more of the categories, the user is given the ability to edit the entire text on the basis of an interpretation which has been explained or defended in the annotation space. The result is a unique text that draws on editorial knowledge and results from a collaboration between author, previous editors, and the present user.

iv. *Fostering the student's experience of writing in the style of the author being studied.* The Mix and Match environment invites the student to assume the role of the author. Most authors write parallel alternative story lines during the crafting of a story, finally focusing on one linear product. With hypertext, the alternative parallel passages can be linked together to create a literary space in which the story line branches and re-fuses. In this authoring environment the student can consider a larger creative canvas, more than just word-crafting, but story crafting in a unique way. The Mix and Match module (Figure 20) is the first such educational tool ever created. Moreover, once the student has chosen a linear sequence of story modules from within one or alternative versions of a text, she is encouraged to immerse herself more deeply into the author's individual style in the process of authoring transitions from one story block to the next. For example, in the Ten Indians (Hemingway) project, students create a new story line and then they must craft its transitions in their best Hemingway-esque style.

Recently, two modules have been added to the system that extend the student's experience of the process of scholarship. Indeed, these two modules can be used as powerful research tools. "Variant Collator" compares alternative versions of any text, detecting and marking the variant passages for conversion to active substitutional hypertext. This marked text can then be imported into the Hypertext Explorer, where it is converted to substitutional hypertext. No longer is any text safe from our intrusion.

Citations

Bolter, J.D. (1991). *Writing Space, The Computer, Hypertext, and the History of Writing.* Hillsdale, N. J.: Lawrence Erlbaum.

Landow, G. (1992). *Hypertext: The Convergence of Contemporary Critical Theory and Technology.* Baltimore: Johns Hopkins University Press.

Nelson, T. (1992). *Literary Machines 93.1.* Sausalito, CA: Mindful Press.

Ross, C.L. 1996. The Electronic Text and the Death of the Critical Edition. *in The Literary Text in the Digital Age*, ed. R. J. Finneran. Ann Arbor: University of Michigan Press.

Ross, C.L. & D. P. Buckley. In press. Teaching Lawrence Hypertextually. *in Teaching Lawrence.* New York: Modern Language Association.

Tufte, E.R. 1997. *Visual Explanations: Images and Quantities, Evidence and Narrative.* Cheshire, CT: Graphics Press.

Technology meets Pedagogy in Online Distance Education

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Abstract: This paper discusses the experience of making the transition from custom-built web course development to the use of WebCT. The experience revealed the strengths and weaknesses of WebCT for delivering a learner-centered, discussion oriented graduate course. The two key issues that emerged were the impact of the underlying educational metaphor of WebCT on course design, and the impact of some of the default settings of the "bulletin board" on student cognitive access. Our experience also demonstrated the importance of using pedagogy to drive the technological decisions in web-based course development.

1. Introduction

This paper examines how technology and pedagogy came together to both facilitate and thwart attempts to develop an interactive and collaborative networked learning environment that was designed to promote higher level thinking. The literature on web-based distance education, online learning and educational computer conferencing is replete with references to its potential to create a new learning environment in which interaction, collaboration, knowledge building and critical thinking are the defining features [Harasim et al. 1997; Haughey & Anderson 1998; Hiltz 1997]. Although, [Bullen 1998] found that creating an interactive online learning environment that promoted critical thinking depended on more than simply creating the appropriate technological environment.

In September 1997 the University of British Columbia and the Monterrey Technical Institute in Mexico, launched a collaborative online postgraduate *Certificate in Technology-based Distributed Learning* that sought to exploit the interactive, collaborative and knowledge-building potential of web-based instruction [Bullen & Salinas 1998]. The first three courses in the program were custom-built web-based online courses. However, in the fall of 1998, a decision was made to use WebCT for the fourth course and the revised offering of the second course which were both offered in January 1999.

One course, *Social Issues in Technology-based Distributed Learning*, made full use of the WebCT environment while the other course, *Selecting and Using Technologies for Technology-based Distributed Learning*, could be called a hybrid WebCT course.

Moving from the custom-built environment to WebCT posed some interesting challenges for both the instructor/developers and the students. The experience revealed the strengths and weaknesses of WebCT for delivering a learner-centered, discussion-oriented graduate course. Two key issues emerged from this experience:

1. How the underlying educational metaphor of WebCT affects its functionality and the impact this has on the type of online learning environment that can be developed.
2. How some of default settings of the "bulletin board" feature of WebCT appear to have affected students' cognitive access.

2. The Online Environment

For the first three courses a custom-built interface was developed that provided the organizing structure for the online course. For online discussions and group work, Hypernews, a freeware, Unix-based discussion forum was used. This was integrated into the course by applying the same navigational interface. Moving from the pages of course content to Hypernews was seamless. The interface was designed to be graphically lean to maximize download speeds, but also to be as functional and efficient as possible. All major sections of the course were always within a maximum of two "clicks". Synchronous chat was not a required component in the course, but a link to ICQ was provided and students were encouraged to use this to communicate amongst themselves when organizing their group work.

Student reaction to the custom-built interface was overwhelmingly positive. Most commented that they appreciated its functional efficiency and our deliberate decision to avoid the use of unnecessary graphics. Initial reaction to Hypernews was mixed. Some students found it slow and the interface confusing. However, as the course progressed and students became familiar with how it worked, the complaints diminished. This feature did not figure prominently in the post-course evaluation.

With the fourth course in the program, *Social Issues in Technology-based Distributed Learning*, a decision was made to use WebCT, a web course development package that provides an integrated set of course development and administrative

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tools. We had avoided WebCT initially because we felt it was too inflexible and linear in its earlier versions. However, we were sufficiently impressed by the updates and we were also looking for a way to decrease the amount of technical and administrative time that was being spent on web course development.

3. Problems with WebCT

Two major problems emerged in our use of WebCT: the inflexibility of the navigational interface, and the confusing structure and interface for the "bulletin board". On the positive side, course development was speeded up considerably and the course management tools have made course administration much easier.

The WebCT navigational interface makes it very difficult, if not impossible, to create a course structure that does not conform to the default WebCT structure. So, for example, we found it was impossible to map our "maximum two clicks away" feature of our custom-built environment onto the WebCT interface. In the end, we had to make some compromises that resulted in a less efficient interface.

But the most serious problem we encountered was with what WebCT calls its' "bulletin board". This is perhaps the most critical feature of these online courses because we are trying to exploit the unique interactive features of online instruction in order to promote and facilitate collaboration, and higher order thinking. The bulletin board interface and underlying structure frustrated these attempts and student reaction, at least initially, was overwhelmingly negative. Some examples of the problems:

1. Links to the "bulletin board" from a page of notes automatically takes students into a default forum called "Notes" and it is impossible to change to another forum without first returning to the home page and reentering the bulletin board. There is also no way of eliminating or renaming the Notes forum.
2. When students first enter the bulletin board they are presented with a list of ALL the unread messages in ALL the forums. The poorly designed interface does not make this clear and students are usually bewildered by the list of apparently unrelated message titles that appear on their screen.
3. The first person who posts a message in a thread creates a subject line and this cannot be modified by respondents. All messages except the initial message are only identified with the student's name. This makes the list of message "titles" absolutely meaningless and makes returning to review the transcript very difficult since no contextual clues are provided. This was a particular problem with the Technical Issues forum where it would have been useful if each message had a subject line that indicated the nature of the technical problem so that students could use this a reference source.

4. Conclusion

The underlying issue with many of the technical problems is that WebCT was initially developed as a web-based adjunct to a traditional teacher-centered classroom model of teaching. It was essentially developed as a way to post course notes on the web. Over the years it has gradually evolved away from that, but it still has not been able to completely shed its origins. This creates serious problems for course developers who are trying to move away from a teacher-centered model and are trying to exploit the unique features of web-based instruction. In the end, I think pedagogy has triumphed over technology and we have been able to create a collaborative, interactive, learner-centered online environment, but it has taken a lot of effort, particularly on the part of students.

5. References

[Bullen 1998] Bullen, M. (1998). Participation and critical thinking in online university distance education. *Journal of Distance Education 13*(2), 1-32.

[Bullen & Salinas 1998] Bullen, M. & Salinas, V. (1998, September). *Postgraduate program in distance education and technology: online instruction transcending national boundaries*. Presentation to the Conference of the Consortium for North American Higher Education Collaboration, Vanouver, BC, Canada.

[Harasim et al. 1997] Harasim, L., Calvert, T., & Groeneboer, C. (1997). Virtual-U: a web-based system to support collaborative learning. In B. Kahn (Ed.), *Web-based instruction*, pp. 149-158. Englewood Cliffs, New Jersey: Educational Technology Press.

[Haughey & Anderson 1998] Haughey, M. & Anderson, T. (1998). *Networked learning*. Toronto: McGraw-Hill.

[Hiltz 1997] Hiltz, S.R. (1997). Impacts of college level courses via asynchronous learning networks: some preliminary results. *Journal of Asynchronous Learning Networks, 1*(2). http://www.aln.org/alnweb.journal/issue2/hiltz.html

Distance Learning and Persons with Disabilities

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Abstract: Using the Internet to deliver distance learning has the potential of reaching everyone, including instructors and students with a wide range of abilities and disabilities. Maximizing access is a worthy goal and is mandated by law in the United States. Universities and other institutions should take steps to assure that their distance learning offerings are accessible to people with disabilities. Making programs accessible is not difficult when universal design principles are applied during the design process.

The Internet provides a medium for the delivery of distance learning with the potential of reaching everyone, including instructors and students with a wide range of abilities and disabilities. Maximizing access is a worthy goal. It is also mandated by law in the United States, where the Americans with Disabilities Act of 1990 requires that programs and services be accessible to people with disabilities. In 1996 a Department of Justice ruling clarified that ADA accessibility requirements apply to Internet resources. Universities and other institutions that offer distance learning courses should give serious thought to the accessibility of their programs. Almost anyone can access the Internet thanks to recent developments in adaptive technologies. Special hardware and software that allow people with a wide variety of disabilities to operate computers include voice output for individuals who are blind or have reading-related disabilities; screen image enlargement for those who have poor vision; and voice input, mouse replacements, and keyboard alternatives for those with physical disabilities. Equal access requires that all of these individuals be able to participate in a distance learning program, regardless of the adaptive technologies they might use with their computer systems.

Course Design and Tools

Applying "universal design" principles to distance learning means to design a course so that it is accessible to students and instructors with a wide range of characteristics, including disabilities. Making Internet-based distance learning programs accessible is not difficult when universal design principles are applied during the design phase. This approach is in contrast to the typical approach of considering only the largest market segment when designing the presentation of Internet resources and services. The following paragraphs summarize some of the access challenges and demonstrate how universal design principles can be employed to make an Internet-based distance learning class accessible to individuals with disabilities.

Electronic mail is an excellent way to distribute information and communicate with students who have a wide range of disabilities because it is text-based and simple in format. Those with visual impairments can read the materials using voice output or screen enlargement. Furthermore, students with hearing impairments do not require interpreters. Other communication systems, such as electronic bulletin boards and conferencing software, are not always accessible to individuals with some types of disabilities; they should be evaluated and tested to assure that they are compatible with voice output and other adaptive technologies.

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For a distance learning class, course lessons and other materials are often placed on a series of World Wide Web pages. Some people who use the World Wide Web cannot see images or hear sounds. If graphics and pictures are included, ALT attributes, captions and transcriptions should be provided so that the voice output systems of blind students and instructors can read the text. Advanced features, such as image maps, may require that alternative text versions of the content be provided. For example, when a blind student using a text-based browser such as Lynx encounters an image map, her voice output system speaks the words "image map". She does not have access to the graphic display nor the embedded links unless the page developer provides an alternative text-only presentation of the content and navigational features. Similarly, video and audio presentations should include captions or transcriptions for deaf participants. In addition, simple and consistent page designs and clear, simple language benefit everyone, but particularly those with visual impairments and/or learning disabilities. All buttons, links, and other standard materials should be placed on each page in the same position. Contrast between background and text should be maximized for those with visual impairments and designers should consider that fact that some users of their sites might be colorblind. In addition, screen buttons should be large enough for selection by people with limited fine motor skills.

The Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) has published guidelines for making Web pages accessible to people with disabilities. The guidelines are:

1. Provide equivalent alternatives to auditory and visual content.
2. Don't rely on color alone.
3. Use markup and style sheets and do so properly.
4. Clarify natural language usage.
5. Create tables that transform gracefully.
6. Ensure that pages featuring new technologies transform gracefully.
7. Ensure user control of time-sensitive content changes.
8. Ensure direct accessibility of embedded user interfaces.
9. Design for device-independence.
10. Use interim solutions.
11. Use W3C technologies and guidelines.
12. Provide context and orientation information.
13. Provide clear navigation mechanisms.
14. Ensure that documents are clear and simple.

The WAI guidelines, explanations and examples can be found at the WAI Web site at http://www.w3.org/WAI/. Other useful guidelines and resource links can be found at many sites on the Web. They include DO-IT (Disabilities, Opportunities, Internetworking and Technology), http://weber.u.wshington.edu/~doit; EASI (Equal Access to Software and Information), http://www.isc.rit.edu/~easi; the National Center for Accessible Media (NCAM), www.wgbh.org/ncam; The Trace Research and Development Center, http://www.trace.wisc.edu; and WebABLE, http://www.webable.com/.

The Web pages for a distance learning class should be tested for access using a variety of monitors, computer platforms, and Web browsers (including a text-only browser such as Lynx) and, ideally, by individuals with disabilities. In addition, a site can be tested for accessibility using "Bobby." Bobby, created at the Center for Applied Special Technology, is an HTML validator program that tests for accessibility and identifies non-standard and incorrect HTML coding. Bobby is located at http://www.cast.org/bobby.

The Internet has a unique place in providing information access to everyone. It provides a means for people to access courses that are not taught locally and to access courses that, due to their disabilities, would be difficult to take in another way. Choosing and developing course materials with access to disabled students and instructors in mind is not difficult, but requires forethought. With this forethought, it is possible to deliver a distance learning class that is available to all students, with and without disabilities.

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A Web-based Teaching Timetable Scheduler

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Abstract
In a tertiary education environment with a lecture/tutorial teaching method, there is often a need to recruit casual teaching staff and allocate them to tutorial and laboratory classes based on their preferred teaching times. This process can be simplified and automated using the Web-based tutor recruitment package to capture preferred teaching times and using a Web-based teaching timetable scheduler to perform the allocation of teaching staff to classes. This paper presents a web software application that will assist academics responsible for the allocation of casual teaching staff to classes. The paper describes a teaching timetabling process, identifying the major components of the scheduler .

1 Tutor Recruitment Package

Traditionally, assistant lecturers in the School have been responsible for the generation of teaching timetables and scheduling of meetings. To assist in this responsibility a tutor recruitment package was developed on the Web [Carbone, 1997]. The tutor recruitment package can be viewed by any Web browser that supports forms and Hypertext Markup Language (HTML). It was designed in accordance to the four design principles for creating interactive multimedia news Web sites [
into the following four components:

- An outline of the requirements and qualifications needed by a candidate.
- List of subjects requiring tutors.
- An outline of the teaching duties and administrative responsibilities expected of front line teachers.
- The tutor recruitment form. The form lists the possible class times and meeting times planned. Each postgraduate enters their personal details including a contact number, previous teaching or related experience, and the subject they wish to teach with a list of preferred teaching times. After submitting the form, a script is invoked which produces a series of text files as output. Each text file represents a subject and contains a list of applicants with their personal details and a ranking of their preferred class times.

2 Scheduling methods for the Teaching Timetable Scheduler

Although timetable scheduling has been a source for much research [de Werra 1985; Selim 1992; Costa 1994] the scheduling algorithms used in this application are based on methods used to manually allocate tutors to classes such as; First-Come-First-Serve (FCFS) and a Priority-based. Both methods are described below and are used to automate the preliminary teaching allocation. The Teaching Timetable Scheduler uses one of the text files generated as output from the Tutor Recruitment form. A CGI program reads the tutor's preference list, executes a scheduling algorithm and creates a HTML timetable (see Figure 1) on a new screen using JavaScript commands. There are four components of Teaching Timetable Scheduler, namely the File section, the Edit section, an Auxiliary section and Help section.

2.1 Scheduling Methods

2.1.1 First Come First Serve

The FCFS method is performed in three passes. The first pass assigns each applicant to their preferred teaching time. Counters are used to keep tabs on the available number of classes for a particular time slot and the number of classes an applicant requires. Once an applicant has been assigned his/her preferences, the same process is repeated for the next applicant until all applicants have been processed. Any unfilled preferences, (with information about the applicant) are retained for allocation in the second pass. Pass two attempts to reassign some of the classes to applicants with unfilled preferences. This process is achieved by examining the class assignment of those applicants whose preferences are the same as the applicants with unassigned classes. If the preference list of the last assigned applicant contains a class not yet allocated, this applicant is transferred to a new time slot, and the unassigned applicant is then moved to the last applicant's preference. Pass three repeats the method described in pass 2.

2.1.2 Priority-based Method

The Priority-based method performs the allocation based on the status of an applicant. A applicant may either be an honours student, a postgraduate student or known as other, indicating they may be of a higher academic ranking or employed from outside the university. The Priority based method is similar to the FCFS method using a three pass algorithm.

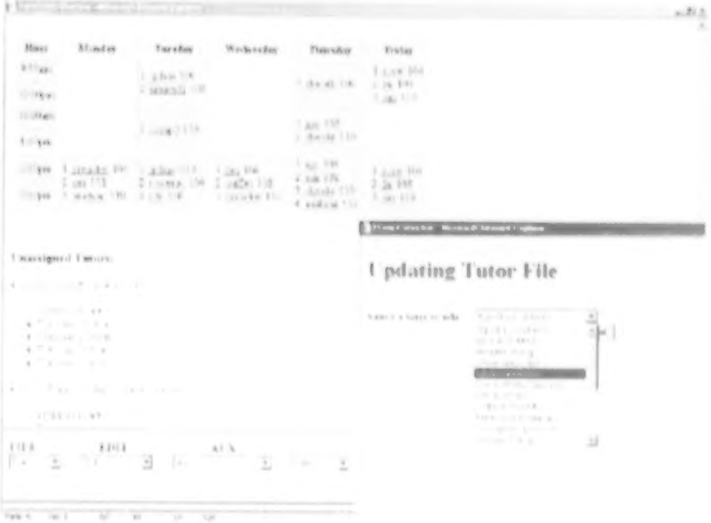

Figure 1 CSC1030 Laboratory Timetable
(generated using the Teaching Timetable Scheduler)

3 References

Carbone, A. (1997). Selecting the right person for the job - An interactive tutor recruitment package on the World Wide Web. *Proceedings of the Seventh Annual Meeting of the Internet Society* (INET'97), Kuala Lumpur, Malaysia.

Costa, D. (1994). A Tabu Search Algorithm for Computing an Operational Timetable. *European Journal of the Operational Research* 76(1): 98-110.

de Werra, D. (1985). An introduction to timetabling. *European Journal of Operational Research* 19(1): 151-162.

Quintana, Y. (1996). Design of Internet-Based news delivery systems and its impact on society. *Proceedings of the Sixth Annual Meeting of the Internet Society* (INET'96), Montreal, Canada.

Selim, S. M. (1992). Computer Algorithms for constructing the Departmental Timetable. *Computers and Education* 18(4): 293-299.

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Academic Integrity and Web-Based Instruction

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Abstract: This paper focuses upon the issue of academic integrity as it pertains to on-line, distance learning, or web-based courses. This type of instructional delivery system is proliferating throughout higher education because it offers freedom from traditional class schedules, allows students to work at an independent pace, and creates additional revenues while requiring few resources. While these aspects of on-line coursework are attractive the open access, the electronic medium, and the unsupervised environment associated with distance learning create situations where plagiarism and cheating can easily take place. Anecdotal examples of web-based cheating are cited along with methods used by the author to identify instances of cheating. Ways and means to design web-based courses and ensure academic integrity are discussed.

A search on the Internet demonstrates that institutions of higher learning are developing courses for the World Wide Web at an exponential rate. These on-line, distance learning, or Web-based, courses can appeal to a wide and diverse geographic area, offer freedom from traditional class schedules, and allow students to work at an independent pace. From an institutional perspective, these courses create additional revenues while requiring few campus resources such as classroom space, heat, lights, or ventilation. While many positive aspects of on-line coursework are attractive, both pedagogically and financially, the open access and unsupervised environments on the World Wide Web create situations where plagiarism and cheating can easily and effortlessly take place. Academic institutions involved in on-line coursework should plan and implement procedures to ensure that the same academic standards that are applied to traditional classes are similarly applied to on-line courses.

The ability to provide educational opportunities to individuals who would otherwise have limited ones is rewarding and exciting. In expanding academic offerings and in making education more accessible, many colleges are enrolling students who live in remote locations. Individuals located in the Amazon basin or at a military post can enroll on-line, obtain instructional materials, submit assignments, and complete course requirements without ever setting foot on campus. Educators, however, must be cognizant of the fact that in giving up the traditional classroom managerial role, they create potential situations that also jeopardize academic integrity. In assessing skills and awarding academic credit, academicians must face the reality that the person taking the course may not be as represented or may be receiving assistance on submitted materials.

From a purist's perspective, the pursuit of learning benefits only the learner. It would thusly seem contradictory to suggest that someone would enroll in a course only to receive assistance and cheat, thereby only cheating him/herself. Those of us who are more experienced and perhaps more cynical understand the reality of coursework deadlines and of striving for top-notch grades. Some companies or organizations offer incentives in the form of promotions or bonuses for attainment of degrees. High grades can assist students in receiving scholarships, grants, and fellowships. In many states, elementary and secondary schoolteachers must complete additional coursework to receive permanent teaching certification. In other cases, any knowledge gained from coursework is ancillary to the actual job, no additional tasks, job advancement, or job knowledge will result from completing these courses. Advancement or salary increments are based upon the completion of a specified number of credits from an accredited institution.

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As an example, one school district provided cash stipends for teachers who completed a specified number of credits from an accredited college or university. Six teachers enrolled in the same on-line course at a college. Once they had received the assignments, they divided the work, each assuming responsibility for one or two units of study. They exchanged completed materials and then submitted all required units, completed the course requirements, and received their cash stipends. While this is a particularly sad commentary given the profession of the persons involved, a loosely supervised on-line course provided too easy a vehicle to accomplish the goal.

In another instance, an employer provided similar educational incentives to upgrade worker skills. The accumulation of ten (10) college credits would qualify workers for a pay grade increase and consequently, more money. A grade of B or better, however, was required for monetary reimbursement. Two employees sought to receive the pay increase and each one enrolled in two five-week distance courses. Each worker completed one course. They then exchanged course materials and resubmitted them. Unfortunately for them, the instructor compared submissions, found similarities, and failed both students in both courses.

In seeking to ensure academic credibility there is much at stake, both from the student and from the academic perspectives. To prevent abuses, instructional developers can design courses with alternative assessment methods that will help ensure academic integrity. Such assessment methods include structuring timeframes, reviewing submissions comparatively, and requiring a proctored final exam.

Web-based courses can include a structured timeframe similar to that of traditional classes. Web-based instructors should not fall into the immediacy mentality of the Internet where information and exchanges are expected on a moment's notice. At the outset, interactive on-line sessions can be planned in advance so that students can count on receiving assistance at designated times. Instructors can post and keep Internet "office: hours where students "chat" and interact with the instructor on a regular basis. While this will not prevent cheating, it will provide students with ample access to the instructor and set a pattern of interaction. In this manner, instructors will become "familiar" with each student's style.

When assignments are received, submissions should be reviewed comparatively. Each student will leave a unique signature in a submission. It may be as subtle as the as the style of entering a date or the location of their name. Some students will always include a cover page or graphic image; others will repeatedly misspell or misuse the same word, even with the assistance of a word processor spelling or grammar checker. In a time crunch, copying another student's file is a very easy alternative to spending long nights completing the work. A publicized policy addressing the commitment of dishonest acts and the penalties for doing so provides the instructor with the necessary enforcement tools.

Final course assessment is another tool available to assist the instructor in assessing learned skills. One option is to stipulate that passing a comprehensive final exam is a requirement for passing the course. In cases where a student copies and submits all assignments completed by another student, proficiency must be demonstrated on the final, regardless of the number of points already accumulated through other assessment methods. Instructors can also require that students take a final exam on campus. If the student can not come to the campus, a designated proctor can supervise the exam at an off-campus site. At remote locations, teachers or clergy can be employed as proctors. When students appear for exams, they should provide a valid form of identification such as a driver's license or a passport. If the final assessment is a demonstrable skill, live video in real-time over the Internet is a viable alternative. If such equipment is unavailable, proctored videotaped demonstrations may be an acceptable substitute.

Academic institutions are responsible for establishing standards. These standards have meaning to the members of society who place importance upon the acquisition of knowledge and the achievement of excellence. As web-based instructional modalities become increasingly commonplace, academicians must preserve learning standards. These standards can be preserved through planning and implementing measures that ensure on-line courses have the same integrity and credibility as do traditional classes, thereby protecting the reputation of the college or university.

Building "My City"

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Abstract: "My City" is an educational hypermedia application designed to stimulate meaningful learning. The application, in contrast to the traditional ones, presents an open scheme based in an external data source that has the possibility of automatically generating a WEB interface. There are exposed some aspects of model based design for hypermedia applications, and an innovative metaphor is proposed for the developing of hypermedia learning tools. Finally, a proposal of methodological use of "My City" is discussed.

1. Introduction

In the last years, we have witnessed a growing use of hypermedia software in several educational areas [Jacobs 92; Kafai et al. 94; Sánchéz et al. 95; Müldner et al. 97]. This tendency is gradually integrating, and even substituting the traditional approaches of computer assisted education and the intelligent tutorial systems. The current work presents "My city", an open hypermedia approach based in web technology, that provides an educational framework to explore (maps, photos, history, sightseeing, etc.) and learn about a town.

According to the hypermedia software taxonomy proposed by [Lumbreras et al. 97], "My City" can be classified as presentation, representation or building of knowledge, and can be used in civic and research education activities.

"My city" is postulated as an open system. In effect, the multimedia database that supports the information presented in the application can be easily expanded or changed by learners engaged with the application. For instance, the version presented here is based on Asunción - Paraguay, but the information represented here can be easily substituted to offer relevant data about any other city like New York.

The open nature of the application allows the use of a workbook metaphor instead of the traditional multimedia encyclopedia. The initial information is organized according to a well-defined structure, and stimulates learners to enrich it depending on new discoveries.

2. Designing "My City"

The traditional hypermedia encyclopedias present some problems. First, their content does not change in time. This implies that the information can be read and browsed but not edited by learners. Secondly, in general, these applications do not separate the presentation mechanism from the data. This implies that the contents must be global enough to be shared by a large group of learners. Another inconvenient is the difficulty to develop activities in which the learner is allowed to build his own information and knowledge.

So, if "My City" were organized as an encyclopedia, it would probably suffer of the same weaknesses. Moreover, it will not fulfill the most relevant feature that we expect for this application: to facilitate change in content. In effect, it is expected that teachers and learners will be able to customize the database, with the specific characteristics of their own cities, neighborhoods, etc.

The metaphor of a workbook was chosen to provide a basic organization to present information, a database and tools to construct new information and knowledge according to educational goals. In order to achieve the later, the main design requirements proposed were:

- integrate relevant information about the city
- organize the information in well defined structures
- facilitate the change of the content to adapt it to specific situation
- offer accessibility to a wide range of learners
- stimulate the construction of new information based on the previous one
- propitiate an adequate navigation system and
- assure the possibility of using an effective searching tool to find particular information.

Several authors have proposed different models and methodologies for the design and development of hypermedia applications and systems [Garzotto et al. 93, Halasz et al. 94, Isakowitz et al. 95, Schwabe et al. 96]. Those models offer to the designers different advantages to face in an efficient way the structural and navigational complexities. Considering that "My City" shows a regular structure, (a city is formed of neighborhoods that have streets, point of reference, etc.) and foresees a volatile content, RMM (Relationship Management Methodology) [Isakowitz et al. 95] is the model that suits best to the requirements of this application.

3. Using "My City" in Learning Process

At a basic level, it can be used as a source of information about Asunción. However, this usage, even though important, it is not the most interesting one because it is limited to the presentation of the information but not improving the learning in a significant way. A very interesting learning level could be reached if the student acquires skills such as reading and orienting himself in the virtual map.

Moreover, this can be easily integrated with challenges like solving problems to find things, i.e., children could identify a convenient path from their houses to the school; considering that the streets could have related information about their respective traffic jam, number of available lanes, etc., it also can help more advanced students to solve real life problems of operative research as finding the shortest path between two points or the hypothetical urban transport paths.

The most interesting feature of "My city, is that the learners could generate more information to be added to the one already available. For instance, they could produce information about their own neighborhoods or even imagined one, display it in a convenient format, and finally publish it, so they are building their own city on the base of a predefined structure.

4. Final Discussion

This work presents a building experience of "My City", an hypermedia web based application, connected to an external database, that leads to the presentation and representation of information and relevant knowledge concerning Asunción, capital city of Paraguay.

However, the most interesting feature of "My City" is that it is an open system that presents a well-structured organization of the information that can be easily widened.

In this way, it is possible to stimulate students from different places, encouraging them to build projects about their own cities, being it the reflection of their own reality or a product of their imagination.

It also has to be mentioned that this experience has allowed a first analysis of the utilization of RMM [Isakowitz et al. 95] in the design of these kind of educational hypermedia applications In the future, "My City" will be used in several educational centers for its evaluation.

5. References

Garzotto, F., Paolini, P., & Schwabe, D. (1993). HDM - A Model-Based Approach to Hypertext Application Design. *ACM Transactions on Information Systems*, 11 (1). 1-26.

Halasz, F., & Schwartz, M. (1994). The Dexter Hypertext Reference Model. *Communications of the ACM*. 17 (2). 30-39.

Isakowitz, T., Stohr, E.A., & Balasubramaniam, P. (1995). RMM: A Methodology for Structured Design. *Communications of the ACM*. 38 (8). 34-43.

Jacobs G. (1992). Hypermedia and Discovery-Based Learning: a Historical Perspective. *British Journal of Educational Technology*, 23 (2). 113-121.

Kafai, Y., & Solloway, E. (1994). Computational gifts for the Barney generation. *Communications of the ACM*, 37(9), 19-22.

Müldner, T., & Reeves, T. (1997). *Proceedings of Educational Multimedia/Hypermedia and Telecommunications World Conference*, AACE, Calgary, Canada.

Lumbreras, M., & Sánchez, J. (1997). Hyperstories: A model to specify and design interactive educational stories. Baeza, R., (Editor). *Computer Science*, USA: Editorial IEEE Computer Society, Los Alamitos, California. 135-146.

Sánchez, J., & Lumbreras, M. (1995). Interfaces for learning. Anzai, Y., Ogawa, K., & Mori, H. (Editors) *Proceedings of Human-Computer Interaction – HCI'95*, Elsevier Publishers, New York. 865-870.

Schwabe, D., Rossi, G., Barbosa, S. (1996). Systematic Hypermedia Application Design with OOHDM. *Proceedings of the ACM International Conference on Hypertext - Hypertext '96*, Washington, U.S.A. 116-128.

Design as Learning; Design as Teaching: Embedding Pedagogy in Web-based Course Design

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Abstract: Most Web-based courses are delivered by systems that are designed for information delivery and retrieval with no evident teaching or learning strategies apparent to the student. A menu offers access to various components in no apparent sequence or order of importance. To assist faculty members in creating and managing more effective learning environments for students, we need templates that are designed to present content or manage interactivity in specific formats that enable specified outcomes. This session will examine several approaches to "pedagogically informed software" and will look at how individual Web-based courses have been customized.

Web-based learning environments can become more effective when they are designed to use their rich hyper-media potential to achieve particular learning outcomes and when media templates ease the task of translating content for the Web. Too often courses are being developed as media conversion tasks, taking classroom elements such as lectures, question and answer opportunities, a textbook, and exams and placing these on line with a syllabus and schedule. Too little thought is given to the essential differences between a physical classroom and the asynchronous, multi-media communications environment of a Web-based learning experience. Faculty authors rarely have assistance reconceptualizing the course to take advantage of these media possibilities for interaction, either within content presentations or sequenced interaction to facilitate specific cognitive or social learning. Approaching the development of a Web course as a design challenge, rather than a resource gathering exercise, allows us to see how learning and teaching issues get reshaped.

This session will examine several approaches to "pedagogically informed software" and will look at how individual Web-based courses have been customized. It will offer insights and demonstrations from the Web Initiative in Teaching, a faculty leadership and courseware development program, for all thirteen diverse institutions in the University System of Maryland with teams from a dozen disciplines. This project started with a summer of design inquiry to help reconceptualize courses, focusing first on learning and teaching issues. www.umuc.edu/ide/wit

Designing for Learning. Design must begin not merely with *what* is to be learned, but also *how* prospective students will learn. As all teachers know, students often don't grasp ideas that teachers think are clear. So much of our teaching is correcting misconceptions, probing ideas, helping students perceive relationships, or make connections to their own life experience. Where a classroom teacher may rely on puzzled looks or restlessness to shift gears, an online course designer needs to consider how such feedback loops are embedded in course processes.

Interaction may be faculty to student, student to students, student to resource, and student to content. Most good Web instructors are conscientious about providing feedback to students through email, chats, or course conferencing. Most appear to include some form of group discussion, usually asynchronous conferencing. Many encourage students to use the Web's search capacities to find resources and people. Few structure material or content to guide students through cognitive processes designed to enhance or deepen learning. Rarely are the interactive processes of online courses designed to engage students over time in a series of interpersonal and content interactions toward particular cognitive outcomes.

Discussion in the online classroom is often used loosely to see "if the students have questions about the material." While clarification is a worthwhile activity, is it sufficient? Some professors even pride themselves in having class discussions in which they don't participate. Yet colleges and universities that have begun looking at outcomes for graduates, usually specify something related to critical thinking or thinking like a professional in the target discipline. How can online courses support or structure dialogue or discussion that promotes these higher order thinking processes? Jon Dorbolo at Oregon State University created his own course structure to achieve the desired sequence of interactions among students and between himself and students to induce them to practice certain patterns of logical thinking and philosophical inquiry in his highly-acclaimed Philosophy 101 course online. The learning process he named "guided autonomous learning," can be used in teaching other disciplines.

Case studies are popular today to teach students how to think like professionals in business, social services, medical studies and other areas. Harvard's business case study methodology is very different from others in juvenile justice or nursing. On the Web most case studies are still primarily presented as text with occasional visual illustrations. What are the possibilities when we take a specific case study methodology and its case-based reasoning and build a template for multimedia learning experiences? This might incorporate certain simulations not possible in the classroom and provide precise feedback on breakdowns in case-based reasoning. How can this template help the instructor not only present the case study "material" but structure the student's learning interactions progressively to challenge and deepen understanding?

Embedding Teaching Strategies. Three decades ago Bruce Joyce, then at Columbia Teachers College, wrote a classic book on Models of Teaching. Each model is based on a learning theory, with a teaching strategy, specific syntax for implementing this strategy with students, and principles for teacher interaction. For example, Harvard psychologist Jerome Bruner's (1960) theory of how concepts are learned led to a strategy for inductive learning. The instructor selects and sequences a set of exemplars of the concept to be taught. These exemplars together with non-exemplars are presented to students. They are encouraged to look for attributes that are shared by positive exemplars but absent from the negative ones. Then students are asked to guess or name the concept illustrated. This hypothesis is then tested with additional exemplars. Either the hypothesis is confirmed or new hypotheses must be generated. After the students have discovered the concept, the instructor helps them reflect on the thinking strategies that they used. This model for "Concept Attainment" makes students more aware of their cognitive processing of information, can aid in memory of large data sets, and can provide provocative, active learning. The generic strategy can be used with students at any age in any discipline. It has particular applicability online where exemplars can be text, images, or video segments of biological specimens, human behaviors, political events or computer objects. One creative variation of this strategy is a CD-ROM component of an Art Exploration course for Britain's Open University.

Diane Laurillard, also at Open University, articulates another generic framework for conversational interaction between teacher and student that is comparable to the syntax of a teaching model. First the teacher presents conceptual knowledge, elicits students' restatements of their understandings, and then helps clarify students' ideas. The teacher guides students toward translating understanding into formal means of representation, such as academic writing, mathematical or logical notation, modeling, computer code, etc. Students act on these representations by solving problems, experimenting, interpreting, etc. Next the teacher assists them in comparing results and restating their understandings hopefully at a greater depth based upon their expanded experience. Finally the teacher helps them reflect upon the process. These steps can be used to design original presentation of material, structure how students continue to interact with these ideas until they achieve some level of competency desired.

These are a few examples of how knowledge of learning and teaching can be translated into software templates designed to facilitate particular pedagogical outcomes. Such templates can enlarge the repertoire of faculty's teaching skills and their Web authoring options, while increasing active student learning and achievement.

References

Dorbolo, J. (1997). Challenging Students' Paradigms: Web course case study. *The Potential of the Web, 1997*. University of Maryland University College: College Park:MD http://www.umuc.edu/ide/potentialweb97/dorbolo.html

Durbridge, N. H., and Stratfold, M. P. (1996). Varying the Texture: A Study of Art, Learning and Multimedia, *Journal of Interactive Media in Education*, 1 (1): Knowledge Media Institute, The Open University: Milton Keynes, U.K., http://www-jime.open.ac.uk/

Joyce, B. R., Weil, M., and Showers, B. (1994). *Models of Teaching*. Boston: Allyn & Bacon.

Laurillard, D. (1993) *Rethinking University Teaching: A Framework for the Effective Use of Educational Technology*. London: Routledge.

____(1997) "Potential of the Web," *Linkages* 6 (1): College Park: UMUC, www.umuc.edu/ide/linkfa97/linkfa97.html.

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Designing Graphics-Based Online and Web-Enhanced Statistics Courses

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Abstract: A sound instructional design is the foundation for a successful course. This is particularly true for courses delivered through the online medium where web sites replace face-to-face contact, where conferencing replaces classroom discussion, where written narratives replace the spoken word and where the desktop replaces the chalkboard. Rather than attempting to replicate the traditional classroom, instructors must take the familiar elements of the classroom experience and recast them into the on-line medium in such a way to best use its unique features.

In practice, Math courses present special challenges. Math courses are graphics-based with symbols, formulas, tables, charts and graphs of all sorts. Delivering graphic-based content verbally with the use of the blackboard requires little technical skills. When the material is broadcast over the Internet, instructors must be technically savvy and be familiar with equation editing and graph-generating software, gif files, bit map files, not to mention HTML. The task is daunting enough for the instructor. It is impossible to expect the average student, who is already struggling with understanding the Math content, to also acquire these skills in order to communicate with the teacher and fellow students.

To help a student understand a concept or solve a problem, a series of questions and explanations in real time are often helpful. Conferencing online is conducted in a written format with online interactivity taking place asynchronously. When dialogue is asynchronous, other methods and/or techniques will have to be developed.

Before deciding on the optimal balance between using the broadcast and interactive modes, one must first address that which is possible within the context of a graphics-based online course. In this paper, the authors present some of the techniques were used and provide an assessment for comparing a classroom statistics course with one that is offered online.

The design of this online statistics course involves the following steps:

1. Set the Goals and Objectives of the course.
2. Decide on the depth and breadth of the content to be covered.
3. Decide on Text Book(s), software, and/or other materials to be used.
4. Decide on the logic of the structure of presentation.
5. Develop the content and structure for interactivities and the appropriate techniques.
6. Develop assessment tools to determine whether the goals and objectives have been achieved.

The objectives and content of the course are pre-determined and must be consistent with sections offered in the classroom due to the fact that the online course is one of several sections of our statistics course offered to our business majors. Excel was chosen primarily because of its popularity and ease of use to accommodate the wide geographic distribution of the students (an Excel-supported text was used).

The most daunting task for the designer was to come up with a logical structure. Unlike a live classroom situation, the online modality is asynchronous with the student facing a computer screen rather than a live instructor. The online course was structured around the logic that the student needs four steps in learning and retaining the material, regardless the modality. They are: 1) 'Tell me about it' 2) 'Show me how to do it' 3) 'Now, let me do it', and 4) 'Give me a review to reinforce what I have just learned'. The next challenge is to develop the content according to the four steps in the online modality.

Our courses are taught over fifteen weeks with one module assigned per week. Each module contains reading assignments, PowerPoint slides, and the instructor's supplemental notes. These are considered the 'Tell me about it' portion. Step-by-step examples satisfy the 'Show me how to do it' requirement. Homework assignments with solutions and feedback provide students with the opportunity for 'Now, let me do it'. The prepared *Interactive Excel files* and an online Excel Guide fit into all three of these categories. The use of case studies with simulated authentic situations, 'real' data and role playing activities prompt a good deal of student interactivity, add depth and force students to be reflective. Listing of key terms, symbols and formulas are part of the 'Review'. In addition, 'conferencing' software is used for student interaction and feedback with 'suggested topics for discussion' posted each week. The topics are carefully stated to minimize graphic input required.

Simply having all elements of the structure is not enough. The structure must be immediately evident to the student and the coverage must be friendly and thorough. Math is daunting enough for the average business student. The student needs to feel that the course material is accessible and that what the instructor has placed on the web is sufficient to gain a full understand of the subject matter.

Assessment

Having taught the introductory statistics course both online and in the classroom affords an opportunity to do some comparisons. The following are some qualitative findings from both instructors. Online students must be more self-directive, and although they use online conferences and email, they still need to dig out the material for themselves. As indicated by the grade distribution, the online students either understood the material or they did very poorly (evident by the few C's and no D's). Many of them withdrew. Other interesting findings were that students were not shy in expressing themselves in writing and the level of participation exceeded that of the classroom students.

One draw back for the online students is that when students do not even know enough to begin to ask useful questions, they are lost. This is not the case in a live classroom where the instructor can intervene, and through a series of questions and answers in real time, help the student. This is especially important when the student in trouble. Below is a comparison of the grade distributions for two introductory statistics courses.

	A	B	C	D	F	I	Total
Live	7	5	6	6	4	2	30
Online	5	11	4	0	4	1	25

A web-enhanced statistics course was offered last semester with a mixed mode course planned for the fall. It will be possible in the near future to make three or even four-way comparisons.

Cognitive and Motivational Effects of Computer-based Simulations on the Learning of the Human Respiratory System: A Study from the Dual Coding Perspective

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Abstract: This study examined the cognitive and motivational effects of two multimedia simulation modes on factual information, concept learning and problem-solving performance of 156 Malaysian science learners. They interacted with a series of multimedia simulations presented in two different modes. In the concurrent mode, animated graphics and textual information were presented concurrently with redundant audio narration. In the consecutive mode, textual information and redundant audio narration were first presented followed by animated graphics. Students who received the concurrent mode of multimedia simulation obtained a higher gain score compared to students who received the consecutive mode. There was also significant difference in learning gain score amongst the low, medium and high trait-anxiety students in both the simulation modes with medium anxiety students obtaining the highest gain score. The conclusion of this study was supportive of the positive value of the contiguity effect in learning.

Introduction

Visualisation in all modes of instruction continues to be an important variable of research in instructional design. The task now is to determine what combinations of visualisation that is most effective in facilitating student achievement while taking cognisance the student's individual difference. In spite of advances in educational technology, the field of educational psychology lacks a corresponding research-based theory on how to design computer-based instruction using visualisation of words and pictures [Mayer & Sims, 1994].

Aims

Given the research concerns in the preceding section, the purpose of this study was to investigate the cognitive and motivational effects of different modes of multimedia simulation on the topic entitled *"The Human Respiratory System"*, on Malaysian students of different aptitudes. In particular, the goal of the present study was to identify the role of the student's spatial and verbal ability in learning from words and pictures in a multimedia environment. This study also attempted to find out how the cognitive styles and anxiety levels of learners affect their learning in a multimedia environment.

Methodology

In the first part of the experiment was to find the cognitive effects of the two instructional treatment modes on students with different spatial and verbal abilities, cognitive styles and anxiety levels. The second part of the experiment was to find the motivational effects of the two treatment groups on the learners. A 2 x 2 quasi-experimental factorial design was used. First, the simulation modes (concurrent mode versus consecutive mode) were crossed with the spatial abilities of the learners. This was repeated with verbal abilities, cognitive styles and anxiety levels. In the second part of this study, the motivational effects of the two treatment groups (concurrent versus consecutive mode) on learners were studied. There are seven instruments in this study. They were the pretest questions, the posttest questions, the Cattell "Culture Fair" Intelligence Test, the Keller Instructional Materials Motivation Survey [Keller, 1987] and the Group Embedded Figures Test. the Trait-Anxiety Tests, Verbal Ability Test and the Spatial Ability Test.

Subjects

Subjects consisted of 156 high school students chosen randomly from six Malaysian schools. For each school, two intact classes were chosen. The subjects were randomly assigned into any one of the two instructional modes. The first mode is the concurrent mode where animated graphics and textual information on *the Human Respiratory System* was presented concurrently with redundant audio narration. In the consecutive mode, verbal information and redundant audio narration was presented first followed by animated graphics consecutively.

Results

Students who received the concurrent mode of multimedia simulation obtained a significantly higher gain score than the consecutive mode (gain score: 7.96> 5.98). In the concurrent mode, learners with high spatial ability obtained higher gain score compared to the low spatial ability learners (gain score: 8.43 > 7.39). In the consecutive mode, learners with higher spatial ability obtained high gain score than the low spatial ability learners (gain score: 6.90 > 5.17). Learners with high spatial ability consistently obtained higher gain scores in both simulation modes than the low spatial ability learners. In the concurrent mode, learners with high verbal ability obtained higher gain score than the low verbal ability learners (gain score: 8.36 > 7.64). In the consecutive simulation mode, learners with high verbal ability obtained gain score than the low verbal ability learners (gain score: 6.90 > 5.10). Learners with high verbal ability consistently obtained higher gain scores in both simulation modes compared to the low verbal ability learners.Field independent learners obtained a higher mean gain score than the the field dependent learners. (gain score: 7.90 > 6.26). Medium anxiety learners obtained higher mean gain score than the to low anxiety learners and high anxiety learners (gain score = (7.98 > 6.51 > 6.21).Learners obtained higher motivational scores when exposed to the concurrent mode compared to the consecutive mode (motivational score: 136 > 129.85).

Conclusions

The results of this study were supportive of the positive value of the contiguity effect. In a multimedia environment, students presented with the concurrent mode will obtain significantly higher gain score than students presented with the consecutive mode.This study found significant differences in gain score between field dependent learners and field independent learners in both the concurrent and the consecutive mode of simulation. As the concurrent mode was better structured in terms of providing students with a framework for organising knowledge, the field dependent learners would find it more helpful to learn from the concurrent mode than from the consecutive mode of simulation.The study found significant differences in motivational preference between participants in the two modes - students showed higher motivation when presented with the concurrent mode. This finding was consistent with previous studies on motivation and design of instruction conducted by [Toh, 1994] and Rieber [1991]. It is possible that using multimedia simulations with concurrent text and animated graphics and narration as a method of instruction did enhance the motivation of the students in the four areas of attention, relevance, confidence and satisfaction. Second, placing the text contigually with the animation would cue the learner's attention to the learning task.

References

Keller, J. M. (1987). *Instructional Materials Motivational Survey*. Florida State University, Tallahassee.

Mayer, R. E., & Sims, V. K. (1994). For whom is a picture worth a thousand words ? Extensions of a dual-coding theory of multimedia learning. *Journal of Educational Psychology*, 86, 389-401.

Rieber, L. (1991). Computer animation, incidental learning, and continuing motivation. *Journal of Educational Psychology*, 83(3), 318-328.

Toh, S.C. (1994). *The Design and Construction of microcomputer simulations based on learning theories*. Proceedings of the Asia Pacific Information Technology in Training and Education Conference and Exhibition (APITITE 94), 28 June – 2 July, Brisbane, Australia.

Why Are We Training Professors to Become Web Designers?

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Abstract: Many universities are using diverse approaches for training faculty in the use of HTML editors to put class materials on the web. This paper will outline some of the reasons why this process is taking away from more productive endeavors. The paper will address how educational technology personnel need to re-think how they are functioning and provide a new paradigm for preparing faculty to incorporate the web into their teaching. In addition, the paper will address one alternative method that the College of Arts and Letters at James Madison University is using to transfer the burden off faculty.

The Problem

There is escalating pressure on faculty members at all institutions of higher education to produce web pages/sites for their courses. The Chronicle of Higher Education, in an article dated May 27, 1999 taken from a panel discussion on student expectations for technology that was sponsored by the Software and Information Industry Association, states, "some students say the best professors are the ones who bother to make web pages for their courses. And a growing number of students use the quality of course web pages as a deciding factor when picking classes." The editorial goes on to say that some students are also mentioning course web sites in their reviews in student-published course guides. In the commentary, Sue Kamp, director of the education-market division of the software association, says during the panel discussion: "They (students) are coming in technology-literate and are expecting the university to be equally literate."

The above remarks are compelling, and they are placing an increasing demand on faculty to establish their class materials on the web; and it is not adequate anymore to put just a syllabus and some links on a class site. There are certainly some impressive reasons to have particular class materials available to students twenty-four hours per day. A professor's slide presentation can be a great learning tool for students to access anytime they need it; and readings for the class can be distributed in a much more efficient mode. However, it has thrust researchers and teachers into an environment in which they are totally unprepared to confront. Not only do they have to learn a different manner of presentation/delivery, but they must also become designers, technologist and developers overnight to prepare themselves for the new delivery system. Those that leap into the process are frequently unaware of the time it will take to learn the basics, the time it will take to develop a good site, and are more unaware of the time that will be expended to manage and update a site. The above tasks can only take away from the work on subject-matter content, work on curriculum development, work on research, etc. that these people were hired to perform.

Current Solution

James Madison University, like many universities, has chosen to deal with this problem centrally. We have elected to offer "free" training to all faculty and staff that desire to learn how to prepare their course materials on the web. For us, this involves the training of an HTML editor such as Frontpage and learning to transfer files to a web server. In many instances like at James Madison University, the faculty are required to purchase the software to accomplish this activity after the training is finished, are left with the problem of finding time to accomplish the task, and are left dealing with the computing arm of the university to get space on a web server, etc.

The Myth

I have worked in educational technologies and have observed over the past ten years the lack of effectiveness that web training and instructional centers have had on the use of instructional technology for teaching and learning. I have identified several reasons for this fact: training is normally not knowledge-based training (it is geared toward staff training); the faculty does not have the time to train in certain time slots as staff do; and faculty members do not receive the follow-up training that is so important. These factors are all independent of the constraints encountered by the faculty member: time, lack of design abilities, lack of reward, etc. These are powerful reasons why using our content experts as web developers is superfluous.

As an example, I use web pages extensively for my classroom teaching: http://cal.jmu.edu/smad232. I have observed that students lack the visual abilities that are required because they have not looked at enough good design. I have found the web to be a perfect solution to this problem. I have designed my web site so they must look at good design. Although this is a more extensive site than most web sites (although students are coming to expect more), it takes far too much time to develop it. A faculty member could not afford to put the time I invest in my web site and expect to also perform well in the areas he/she is required by the university system.

Alternate Solution

The College of Arts and Letters at James Madison University has created a tool that will allow faculty to drag-and-drop digital classroom material in its native format (Microsoft Word as opposed to HTML) into a folder on the desktop. This instantaneously makes the material available on the web. It allows for faculty to put syllabi, handouts, readings, take-home tests, PowerPoint presentations etc. on the web for access twenty-four hours per day. There is no training necessary since the drag-and-drop process is inherent to all computer users. The material does not need to be formatted (converted to HTML) so browsers can display it. Organizing the material is again fundamental to the user. He/she simply makes folders/directories within his/her desktop folder and drags the material (files) into the folders. He/she can organize according to class, assignment, etc, simply by labeling the folders appropriately. All material can be password-protected if desired.

The student then goes to a page on the web (http://cal.jmu.edu/classmaterials). The student uses the pull-down menu to choose his/her instructor from the list. The learner will then click the "Display Classes" button. The student will be directed to that instructors web page that will contain the folders/directories and files as the instructor has organized them. The student simply finds the material he/she needs and clicks on it. The student may download the material/file for transport or open it immediately. The application that the file was developed in must be on the computer. This is not a problem at James Madison University since most all applications are standardized.

The instrument also allows for an instructor to upload the class material anywhere in the world. The instructor will go to a page on the web (http://cal.jmu.edu/upload.asp). The page allows the instructor to create directories/folders, delete directories/folders, upload files and delete files. At this point, the faculty member has to know more than just the "drag-and-drop' process. The instructor must understand how to fill out and submit forms on the web. Although this seems trivial to many, it does take a small amount of training for some educators in the College.

Summary

Although the tool has been slow to catch on (developed in the Spring semester of 1999 and not advertised), many in the history department are now using the tool. Mostly developed for PowerPoint presentations to be made accessible on the web, the History Department at James Madison University used it to distribute take-home final tests at the end of Spring semester. The faculty members that use it find it to be very useful. The Fall 1999 semester will be the first time in which faculty are able to have the site available to them the entire semester and able to make plans on how they might use it during the semester.

The paper is not to discourage faculty from developing extensive class sites for their classroom teaching. This is certainly an individual decision. However, it is the conclusion of the author that faculty have enough important items on their plate that it is asking too much for them to become web designers, an activity that is totally foreign to most. If we are to have faculty members effectively use the web for classroom teaching, we must change the tools and not have the tools change them.

Teaching a Large Undergraduate Statistic Class.
Phase II: Developing a Web Support Site.

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Abstract: In this paper the authors recount the process of developing an html based trial web site at short notice, designed to support the presentation of lectures and tutorials to a large undergraduate student cohort with minimal funding and a short time frame. The decision to embrace the process emanated from the need to find a mechanism that may alleviate some of the logistical problems associated with presenting a first year statistics subject 'using an experiential approach', to over 300 first year undergraduate students in the traditional face to face delivery mode.

Few academics appreciate the fact that migration to a web based delivery mode of their subject materials is an involved process which can only be successful if several demands are met including: thorough planning; a commitment to the restructuring of materials; re-assessment of the pedagogical approach taken and an awareness that their workload will increase.

Background

The rapid rise in the development of sophisticated and improved technologies has been without doubt one of the key driving forces behind the widespread embracing of the concept of flexible delivery and the application of the many and varied tools upon which it is based, in particular the world wide web, in the field of education. Researchers including, Simbandumwe (1997), and Parson (1997), suggest that there has been widespread increase in the level of interest and use by academics of on-line, instructional systems in the last few years.

"An understanding of the techniques and protocols of on-line teaching and learning and the processes of both the design of new and the conversion of old courses has become essential for academics, as universities throughout the world embrace alternative delivery methods in response to the globalisation of education." (Corderoy & Lefoe 1997)

Development Issues

By default, the academic must often assume the roles of designer, developer and presenter without the necessary skills base or supporting infrastructure. The acceptance of these roles has been eased and supported by the proliferation of 'easy to use' subject building systems currently referred to by many as 'cookie cutters'. However the problems arising out of inadequate instructional design often negate the worth of the resulting teaching and learning environment. It is suggested that ..."the main reason for this is that, very few academics have the expertise in the varied disciplines involved in the production of an effective web based subject. While the 'cookie cutter' development systems generally base their 'templates' on sound pedagogical models, the templates must by necessity be 'one size fits all' in structure. This in itself would not necessarily represent a fatal flaw if it were not for the fact that these development systems do not generally have a sufficient level of in-built user support to allow an untrained academic to use them correctly and efficiently in various situations.
The problem is exacerbated by: time and funding restraints which force individuals into the adoption of a 'cheap and quick solution and the mistaken belief that providing a subject on-line involves little more than providing the content of the subject as a web based document. The authors contend that the most successful methodology is the 'team approach'. "Such a team would have a minimum of four members: a content expert (the academic or lecturer); an instructional designer; a programmer and a graphic artist. " (Corderoy & Porter 1998)

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The Development Key Issues

The issues are many and varied and may be categorised as:

Logistical
Issues including: aspects of student access, financial resources and the availability of developmental expertise.
Instructional Content
Issues including: appropriateness of materials for the delivery mechanism chosen; and media utilised
Management of delivery
Issues including: individualisation of instruction; facilitation of interaction; security and feedback to students.

Recommendations for Prospective Developers

Organizational
Allow sufficient time for, planning; materials preparation; conversion of materials, and testing. Ensure sufficient funding to cover the production cycle and release time for the academic during the curriculum/materials development stage.

Technological
In terms of technology developers should: ensure that they select seamless technology; maintain close collaboration with the 'technical delivery platform' providers; carry out extensive testing early; provide 7x24 support for students; provide staff and student training and, use one of the many Information Management Systems currently available.

Pedagogical
This is a new medium for both the student and the lecturer. Both need to be prepared to be accepting of the problems of all involved.

Conclusion

"Innovative practice will always provide challenges for early adopters of new strategies for teaching. As web-based instruction moves beyond the early adopter stage, institutions will need to put structures into place to support teachers in this new role." (Lefoe & Corderoy, 1998)

References

Corderoy, R., and Lefoe, G. (1997) Tips and Secrets for Online Teaching and Learning: An inside view. in Kevill, R., Oliver, R., and Phillips, R. What Works and Why, 14th Proceedings of Australian Society for Computers in Tertiary Education. Academic Computing Services, Curtin University of Technology, Perth, Western Australia. (pp 647-651) http://www.ascilite.org.au
Corderoy, R., and Porter, A. (1998) Managing the process of synchronous face-to-face and web delivery of a first year undergraduate statistics subject. *"Flexible Learning: Exploring the myths and realities" Apple University Consortium Academic Conference.* Uni of Melbourne, Australia. CD-ROM Publication (ISBN 0-646-35654-2)
Lefoe, G., Corderoy, R. M. (1998) Tips for Effective Online Teaching and Learning. "Online instruction: Trends and Issues II". Teaching in the Community College Online Conference. Sponsored by Teaching in the Community List and Kapi 'olani Community College. April 7 - 9. Hawaii. Papers @ http://leahi.kcc.hawaii.edu/org/ tcon98/
Parson, R. (1997) An Investigation into Instruction Available on the World Wide Web. Master of Education Research Project. [http://www.oise.utoronto.ca/~rparson/ out1 d .html]
Porter, A., & Corderoy, R. M. (1998) "There is only two weeks to go, can I get my subject on the Web?": A Case Study. *Conference Proceedings of the 15th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE). Robert M. Corderoy. Ed.*, University of Wollongong Printery. Wollongong. Australia. pp 571-584
Simbandumwe, J. P. (1997) Tools for developing Interactive Academic Web Courses - The Emerging Model.[http://www.umanitoba.ca/ip/tools/courseware/model.html]

Being Orientated in the Cyberspace, Could it Be a Problem?

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Abstract: This paper intends to discuss some metaphors used to promote navigation and to prevent disorientation in the cyberspace. We analyze two of the most common familiar contexts to the new space: the book and the physical space. These are often used to help users to understand the purpose and function of the information access structures and to help the user to easily build an internal model of the cyberspace (for example, of the World Wide Web). To adapt these familiar cues to promote orientation in the cyberspace is not an easy or a consensual task and there is some controversy in relation this theme.

The Cyberspace

The cyberspace is a new kind of "space" and it can be described as a new electronic territory, as an information space. It emerges mainly from the Internet and its associated environments (World Wide Web, gophers). [Staple 1995] defines cyberspace as "an imaginary world, an artifact of computer software whose form may be as varied as the human imagination". In this new world the challenge for the cybernaut is similar to the one the first Portuguese navigators who discovered the New World had to face: they have to know what they are looking for, how to find it and which is the shortest/easiest path to get to it. For instance, navigating in the WWW can be confusing specially when the users are novices or do not have a clear objective to drive them during the browsing process. Navigation tools as "previous" and "next" buttons are basic forms but there are more tools such as maps, book/ landmarks and history lists. The most sophisticated mechanisms to navigate through the Web are, as described in [Barlow 1998] the Web search engines such as Alta Vista, Infoseek, Excite, Webcrawler, Lycos, HotBot and the Yahoo Directory. They all aim at orienting whoever is browsing in the information in order to help them find what they need, so that they can move on to their next task.

The non-linear principle, which is the most important feature of the hypertext, is the basis for WWW. One breakthrough in this new medium is the linking together of information nodes as a true hypertext. However hypertext creates a contradiction: links to other sources add depth to a Web site, but it can also send the readers away mid-sentence and mid-thought by encouraging them to click somewhere else and thus creating a great confusion in their minds. On the contrary, when we read a book we can hold it and touch it and we also have several visual and tactile cues about the information it offers us. They are called discourse cues and consist in [Kim & Hirtle 1995] aspects such as: organization into chapters and sections, conventions concerning the placement of topic sentences, and typographical conventions that help the reader decide which parts to read in detail, and which parts to skim over. Such conventions have not been established in hypermedia environments yet. This situation grows worse in the cyberspace where the quantity of information and the number of links among the nodes of information can be almost uncountable. Feeling lost, not knowing where to go, not knowing where we are, and finding difficult to select the next node of information, these are some of the problems the users must face each time they interact with a hypermedia system. This "disorientation feeling" [Dias, Gomes & Correia, in press] is bound to cause frustration, since decisions about the node or sequence of nodes to be explored are difficult to make in complex environments.

To this scenario we can add, if we are referring to the cyberspace, the absence of physical context, the increasing need for graphical context cues and the variety of ways a user can arrive to any page of the Web.

How to Use Familiar Contexts to the New Space

The use of a navigation metaphor may be a way of helping the novice user to understand the purpose and function of the information access structures and to help the user to easily build an internal model of the system. The *book metaphor* has often been used to design hypermedia environments, called electronic books. An electronic book [Barker 1995, p.2] is "essentially a collection of pages of electronic information that is organized (conceptually) just like the pages of a conventional book". According to this author most electronic books use some form of graphical user interface and the quality and bandwidth of visual display within such interfaces depends enormously on the spectrum of delivery platforms available. But in almost all computer screens (until now) users read about 25% slower than on a printed book, as [Nielsen 1998] referred. Even when electronic books gain the same reading speed as printed ones, Nielsen claims that the book metaphor will still be a bad idea and justifies this statement saying that: the basic problem is that the book is too strong as a metaphor because it tends to lead designers and writers astray. "Electronic text should be based on interaction, hypertext linking, navigation, search, and connections to online services and continuous update. This new-media capabilities allow for much more powerful user experiences than a linear flow of text" [Nielsen 1998]. However some of the terminology (for example, "page") related to the WWW reminds us of similar elements in a "book". The use of titles, headings, sentences, paragraphs, table of contents and bookmarks in the design of Web pages is very common. But we need to consider that the WWW alters the way we perceive a book or a magazine. Therefore since the computer limits the amount of information visible at any given time on a screen and as this screen depends on the individual WWW browser used as well as on the resolution of the screen, the traditional concept of page has changed. This constraint does not normally occur in text-based print media that allow the reader to leaf through a lengthy reading, and commonly two pages of text are simultaneously on view.

There is also some controversy involving the hypertext discussing whether navigation should or should not be conceived as spatial. [Stanton 1994] classifies the *spatial metaphor* as dangerous. He bases his opinion on the electronic space definition. According to Stanton, majority of the studies done in relation to the hypermedia environment, seems to use the word "space" with the same meaning it is used by everyday-sense where it corresponds to a physical relationship between objects. In this perspective, the electronic space would be equivalent to the physical space. [Stanton 1994, p.288] supports that starting from the concept of hypertext as a multidimensional space, which can be explored in various ways, "space", in this context, must be defined as "the collection of objects and activities contained within a specific domain". [Dias & Sousa 1997] claim that the electronic environments present intrinsic characteristics that do not permit a linear transfer and appropriateness of the geographical environments characteristics'. They suggest that the use of a navigation map in an electronic environment is not as efficient as the use of a map in a geographical environment. The cyberspace has another interesting feature that makes it hard to map. It is infinitely mutable. All maps begin to lose their accuracy as soon as they are printed, as [Staple 1995] referred. However some attempts to design the geography of the cyberspace have been made as we can see on the Web site entitled "An Atlas of Cyberspaces" (URL: http://www.cybergeography/atlas/). This site [Dodge 1999] intends "to help us to visualize and comprehend the new digital landscapes". Some maps we can see in this site use the cartographic conventions of real-world maps, but they are much more abstract representations of electronic spaces, using new metrics and grids to create the so called cybermaps.

References

BARKER, P. (1995).Electronic Books: A Review and Assessment of Current Trends. Paper presented at the *Sixth World Conference on Computers in Education* (Birmingham, United Kingdom, 23-28 July, 1995).

BARLOW, L. (1998). How To Use Web Search Engines (URL: http://www.monash.com/spidap.html).

DIAS, P. & SOUSA, A. (1997). Understanding Navigation and Disorientation in Hypermedia Learning Environments. *Journal of Educational Multimedia and Hypermedia*, 6 (2), 173-185.

DIAS, P., GOMES, M. & CORREIA, A. (1999). Disorientation in Hypermedia Environments: Mechanisms to support Navigation. *Journal of Educational Computing Research* (in press).

DODGE, M. (1999). An Atlas of Cyberspaces (URL: http://www.cybergeography/atlas/).

KIM, H., HIRTLE, S. (1995). Spatial metaphors and disorientation in hypertext browsing. *Behavior & Information Technology*, 14, (4), 239-250.

NIELSEN, J. (1998). Electronic Books - A Bad Idea. *Alertbox* for July 26, 1998 (URL: http://www.useit.com/alertbox)

STANTON, N. (1994). Explorations into Hypertext: Spatial Metaphor Considered Harmful. *Educational and Training Technology International*, 31, (4), 276-294.

STAPLE, G. (1995). Notes on Mapping the Net: From Tribal Space to Corporate Space. *TeleGeography1995: Global Telecommunications, Traffic Statistics & Commentary*, October, 1995 (URL: http://www.telegeography.com/Publications/mapping.html)

Multinational Web-based Training: Issues to Consider

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Abstract: The World Wide Web has tremendous potential to dramatically change the way training is designed and delivered. It can save money for management and increase flexibility for learners. This is particularly true when training is being delivered to multinational locations. This paper reflects on one multinational Web-based distance training experience. The authors examine lessons learned and share recommendations for future Web-based training.

1. Introduction

Training was traditionally delivered in face to face contexts either by sending trainers to remote locations where learners were congregated or by bringing learners to centralized training facilities. Distance technologies present several alternatives to these practiced configurations. This paper reflects on one multinational Web-based distance training experience.

The Web-based training project was initiated in conversations with a large hospitality provider with training needs around the globe. The challenge was to initiate regional directors of training to principles and strategies for distance learning along with specific structures for supporting distance learning in their regions. An initial meeting was held with the directors of training to introduce the basic system of information and delivery that would be utilized for the training and to conduct a basic substantive and technical needs assessment. A full-day seminar style approach was used to establish basic assumptions about distance learning and potential outcomes. An evaluation of the participant's motivation, prior experience, availability, technology access and local training needs revealed a high degree of enthusiasm and commitment to the proposed experience.

The original design included content posted on the World Wide Web (Web), Web-based learning activities, and an asynchronous discussion forum to support discussion and information exchange. There was no attempt to arrange synchronous activities due the fact that the participants were literally located around the world in dramatically different time zones.

Even after the initial basic needs assessment and technology training, several key obstacles occurred during the training. Through dealing with these obstacles, the trainers learned several key principles about Web-based asynchronous training. The purpose of this paper is to share the experiences and solutions learned by the trainers.

2. Asynchronous Training Learning Curve

One of the initial issues that surfaced during the orientation and first week of the training dealt with the learning curve associated with nature of asynchronous distance training. In the beginning of the training some of the learners felt that Web-based asynchronous training was similar to participating in a correspondence course over the Web. They envisioned participating in the training experience once a month when they had available time. Asynchronous distance training does afford a great deal of flexibility for learners; however, the structure designed and developed by the trainers required more frequent participation. The trainers had designed an asynchronous environment full of weekly lectures, activities, assignments and online discussions.

The learners accepted the fact that more participation than they had initially envisioned was necessary for the Web-based training to be successful. In an attempt to meet the needs of the learners, the trainers changed the format of the materials so that the learners would only be required to participate every other week instead of every week.

3. Interface Design

The second issue that arose in the training involved the interface design of the Web-based materials. The trainers chose to utilize a new software product that facilitated the posting of Web pages and asynchronous conferencing. The software allowed the trainers to simply fill in HTML form boxes with pertinent information and the software would then generate the appropriate Web pages. Prior to the training only limited pilot testing had been done with the software product. While that pilot testing had been successful, it did not address all of the issues. Of particular consequence was the interface design for the asynchronous conferencing piece of the software.

The interface design worked fine when there were few users and limited discussions. However, when many users started posting multiple weekly messages, the interface made the process of posting and reviewing others postings extremely difficult. The posting of messages and reviewing of other's messages was so important to the training exercise that the trainers were forced to abandon the initial asynchronous conferencing software. A different asynchronous conferencing software package, which had undergone extensive usability testing, was identified and implemented. The trainers observed that in the future all Web-based products should go through extensive usability testing prior to their use in a training environment. Additionally, as previously mentioned, designers should involve learners early and throughout the design process.

4. Needs Assessment

As discussed, early in the process the trainers participated in a basic needs assessment with the learners. However, a substantive needs assessment dealing with the learner's expectations, technology requirements and previous computer experience should also have been completed. The learner's management team assumed that the learners had enough time to participate in the Web-based training. However, it quickly became apparent that many of the learners did not have the necessary time available to fully participate in the training. After several weeks of partial participation in the training, the management team and the learners agreed that the Web-based training format was more time consuming than initial envisioned. This obstacle is directly tied to the learning curve associated with asynchronous training. Designers of Web-based training should do a thorough needs assessment of management and learner's expectations concerning the time necessary to fully participate in this type of training. This is particularly important for first time Web-based learners. Additionally, Web-based trainers should also do a thorough needs assessment of the hardware, software, internet connection speeds and learner's previous computer experience necessary for successful participation in the training.

5. Conclusions and Recommendations

Web-based training has tremendous potential to dramatically change the way training is designed and delivered. It can save money for management and increase flexibility for learners. This is particularly true when training is being delivered to multinational locations. However, Web-based training involves more than simply creating Web pages. The project described in this paper resulted in several key recommendations for those designing, developing and implementing Web-based training. The key recommendations are:

- Prior to the beginning of the training project, trainers should thoroughly explain to management and learners the prerequisites necessary to successfully complete the training. Of particular importance is the time necessary to participate in the training. In some cases, Web-based training is more time consuming for learners than traditional training.
- Designers should involve learners early and throughout the design process. This can be accomplished through pilot and usability testing.
- All Web-based materials and software should go through extensive usability testing prior to implementation. Interface design is of particular importance to the success of the training experience.
- A thorough needs assessment of the hardware, software, internet connection speeds, and learner's previous knowledge of computers should be completed prior to the design and implementation of the training materials.

Using The Web For Facilitating Problem-Based Learning And Case-Based Reasoning In The Training Of Pre-Clinical Medical Students

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Abstract: Medical schools are continually seeking innovative ways to educate future physicians. Many schools have integrated problem-based learning into the curriculum. Web technology provides a new environment for complementing this educational strategy. This paper discusses problem-based learning as an instructional methodology and shows how the World Wide Web can be used to facilitate the process.

1. Introduction

Medical schools internationally are experimenting with new ways to educate future physicians. In 1986, medical educators from five different countries (China, Mexico, the Philippines, Thailand, and the United States) met at a conference held in Albuquerque, New Mexico, to introduce new methods of educating physicians. The aim of this conference sponsored by the World Health Organization was to discuss establishing an innovative curricular track, distinct from, but running parallel with, the already existing traditional curriculum (Kantrowitz, et. al. 1987). The predominant teaching methodology of this innovative curricular tract was problem-based learning (PBL). Since 1986, several medical schools and institutions that train health care professionals have adopted the innovative curricular track or used PBL and case-based reasoning. Over 80% of medical schools use PBL to teach students about either real or hypothetical clinical cases (Vernon and Blake, 1993). The recent development of web technology has provided impetus to use this environment for facilitating PBL. The paper discusses PBL as an instructional methodology and shows how the World Wide Web (WWW) can be used to facilitate PBL. Examples are drawn from the training of medical students and physician assistants using this approach at Wake Forest University School of Medicine. This medical school merged the problem-based and traditional curricula and is using the web for case-based tutorials. Issues related to using the web for PBL are discussed.

2. What is problem-based learning?

Mayo et. al. (1993) describe PBL as a pedagogical strategy for posing significant, contextualized, real world problems, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills. In PBL students collaborate to study the issues of a problem as they try to come up with viable solutions. Unlike lecture-based instruction, with the instructor being in control, PBL occurs in a small group facilitated by a faculty tutor (Aspy, Aspy, & Quimby, 1993). PBL is learner-centered; learners are given more and more responsibility for their own learning and become increasingly independent of the tutor as they acquire self-directed learning skills. PBL is based on real-life, unanticipated, and ill-structured problems, problems that reflect life beyond the classroom. The problems in PBL are designed to challenge learners to develop effective problem-solving and critical thinking skills. Learners encounter a problem and attempt to solve it with information they already posses allowing them to appreciate what they already know. They also identify what they need to learn to better understand the problem and how to come up with a solution for it. These are called learning issues. Once they have identified what they need to learn to understand the problem better, learners engage in self-directed study and research using textbooks, journals, the web, and talking to a variety of people with appropriate expertise. The learners return to the problem and try to apply what they have learned to resolve it. After they have finished their work with the problem, learners assess themselves and each other to develop skills in self-assessment and constructive peer-assessment. Self-assessment is an important skill that leads to effective self-directed, independent learning. The principle role of the tutor in PBL is one of facilitator who guides learners through the learning and clinical reasoning process. The tutor may also serve as subject matter expert, resource guide, and group consultant.

This arrangement promotes group processing of information (Vernon & Blake, 1993). The tutor encourages student participation, keeps students on track, avoids negative feedback and assumes the role of learner (Aspy et. al. 1993). As students learn to take more control of the learning process, the facilitator becomes less active.

PBL in medical education is similar to the process described above. Medical students meet in small groups of five or six students with a trained faculty tutor. Patient problems are presented in a variety of ways, on print, computer-based formats, as well as simulated patients. Interacting with simulated patients enable the students to develop both clinical and interpersonal skills. Students approach patient problems just as a physician does. They are able to ask questions, carry out a physical examination, and order diagnostic and laboratory procedures, as in the real clinical situation. Faculty tutors guide students in reasoning their way through the patient's problem. The need for information required to understand the problem generates learning issues for further study. Learning issues represent all relevant disciplines. Students are expected to consult a variety of available resources while pursuing the learning issues. As students return with the knowledge they have gained, they apply it to the patient problem and are able to either confirm or reject hypotheses.

3. The web and problem-based learning

The web provides a versatile environment for fostering PBL. Patient cases can be posted on the web; simulated patients can be interviewed via conferencing technologies. Each group can use the conferencing features of the web to form and discuss learning issues. The web is also an excellent medium to point them to additional resources such as databases and experts. Experts in a specific area can be consulted via e-mail for an opinion. Using the techniques of telemedicine, students can review diagnostic information over the web. The application of information gained from the study of learning issues to solve a patient problem can be discussed in a group conferencing format that will facilitate collaborative learning among students and instructors. Web sites that provide good information on PBL are Southern Illinois University School of Medicine found at <http://edaff.sinumed.edu/dept/pblcur.htm>, <http://www.pbli.org/resurces/cases.htm>, and San Diego State University's web site <http://edweb.sdsu.edu/clrit/learningtree/pbl/WhatisPBL.html>.

Wake Forest University School of Medicine just began to use the web for case-based reasoning. Patient cases are posted on the web; the tutors display the page of the case as students request information. The groups can post the learning issues they form and discuss them across the groups (via the web) to get a broader perspective of the level of discussion within each group. In the first year there were twelve groups. There are issues related to both the technological environment of the web for PBL as well as issues students have with the process of PBL. Currently, medical students are not as active in the discussion of learning issues over the web; they interact less over the web than the physician assistant students do. Medical students are still more lecture driven and spend more time studying lecture material. This is because this program is a combination of traditional lecture-based and problem-based formats. To some degree they have a "we'll learn that in the next lecture" mentality, rather than using case material to explore new information on their own. Since this is the first year of the hybird curriculum, many of the issues that have surfaced will be resolved as faculty and students gain confidence in learning via this new medium and methodology. Medical students need to progress more in terms of the self-directedness of problem-based and discovery learning. This is the problem with many learner-centered instructional methodologies as many learners are still very instructor-dependent. Both faculty and students need to be trained to move toward new formats for learning.

4. References

Aspy, D. N., Aspy, C. B., & Quimby, P. M. (1993). What doctors can teach teachers about problem-based learning. *Educational Leadership*, 50 (7), 22-24.

Kantrowitz, M., Kaufman, A., Mennin, S., Fulop, T., Guilbert, J. (1987). Innovative tracks at established institutions for the education of health personnel: An experimental approach to change relevant to health needs. Geneva, Switzerland: World Health Organization.

Mayo, P., Donnelly, M. B., Nash, P. O., & Schwartz, R. W. (1993). Student Perceptions of Tutor Effectiveness in problem based surgery clerkship. *Teaching and Learning in Medicine*, 5(4), 227-233.

Vernon, D. T., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine*, 68 (7) 550-563.

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The Changing, Developing Structure of Education: Current Issues and Future Considerations

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Abstract: Education is a profession that has a living, breathing life of its own; it is constantly changing and developing towards the future. But numerous issues pertaining to education are in existence now, not the future, and these issues must be ascertained, discussed, questioned and considered, so that these current issues will mold, not hold back, the life of education. One area that has significantly impacted education recently is instructional technology and, by all accounts, will continue to have a vast impact on the future. Therefore, instructional technology is one area within the educational realm that impacts the changing, developing structure of education and offers copious points towards current issues and future considerations. As educators, the changing, developing structure of education is an exciting time; however, we must meet current issues, overcome such issues, and move towards future considerations.

Instructional technology is a relatively recent subject matter within the arena of education; however, the impact of instructional technology upon the education of elementary, secondary and postsecondary educational environments have been enormous. The independent school districts and universities alike are scrambling to update their resources and make available technologies to their instructors/facilitators and learners within their distinct communities. But this is only one major concern; once this issue has been met, numerous other current issues are on waiting in the wings. One issue is the training that must ensue so that instructors/facilitators, learners, administrators and other persons intimately involved with the technologies will be cognizant of the abilities the technology will offer their educational situation.

Yet with so many current issues involved within the instructional technological impact upon the educational environment, future considerations must also be a part of the discussion. Questions must be asked and plans must be implemented that will lead the education profession towards not merely the twenty-first century but will offer such theoretical, epistemological, and realistic structure as to develop a basis of understanding concerning where we are now, where we would like to be someday soon, and where futurists view our educational environment in the future. As educators, the changing, developing structure of education is an exciting time; however, we must meet current issues, overcome such issues, and move towards future considerations.

Hardware and Software Availability

Although great strides have been made over the past several years concerning the hardware and software availability within an educational environment, the necessity to remain updated is clear. Governmental moneys have been a viable influence upon the improvements attained in classrooms at all levels of professional education units; however, what will be the future of the hardware and software availability once the governmental moneys have shifted towards tomorrow's area of interest? Will we as educators be left with obsolete hardware and software, as was the case merely a few years prior to the latest accomplishments, or will the educational profession come together to demand equal status as other professionals that work towards a better tomorrow? The students, whether at elementary, secondary or postsecondary levels require the ability to obtain current information. Therefore, hardware and software availability will continue as areas of current as well as future consideration.

Curricular Integration

Curricular integration of technology has recently become highlighted as an area that may be difficult for many educators. Although the hardware and software may be available to the educators and students, the knowledge concerning the integration of technology into the curriculum may be lacking. Educators may have never had the opportunities to integrate technology into the curriculum and, now that technology is available, may be unaware as to the ease of integration.

Conceptual changes in the educators' perception as to not only the educators' place in a classroom environment, but also the students' and technologies' place in a classroom environment may be developing for the educator. Needless to say, conceptual visions and changes take time to occur. Therefore, the educational environment is in a state of flux and may well take several years to successfully integrate technology into the curriculum; however, educators must receive support in order to attain such high expectations of not only themselves and their students, but also of the changing structure of the educational environment.

Distance Education

Although distance education has been an influence over several decades, from postage mail through telephone conferencing through instructional television and then on to interactive television, it was rare to find a high level of interactivity among such conceptions. However, with the booming growth of the Internet, distance education has reinvented itself to offer a higher motivational standard and, perhaps, a higher level of interactivity and quality of educational experience than was previously imagined. Such optimistic beliefs are not without their detractors, but the future will offer the justification towards the formative years of distance education.

Training

Future considerations would not be complete without discussions surrounding the training of professional educators within the realm of technology. Without such training opportunities, the whimsical belief that educators have the unencumbered time to "figure out" the educational implications of technology is naïve. Along another line of thinking, training situations are excellent opportunities for research into the implications and effectiveness of training sessions at all levels of education.

Conclusions and Future Considerations

Numerous current issues surround the educational profession, of which technology is one. But for technology being only one of many issues, the technologically related areas of interest at the moment are numerous. But what of the future considerations? The future is, at best, unpredictable. Yet we must venture to hypothesize as to the levels of importance that each of our current issues will attain in the future. Through numerous considerations and professional discussions, we as a profession may come together as a strong body who will mold the future of education, and the technological implications therein, for the betterment of not only our own profession but also the education of our students. Herein the strength of our endeavors lie.

Crossing Over Disciplines: Three Academics Share Distance Education Design Experiences in Education, Administration and Health Sciences

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Abstract: The purpose of this paper is to relate the findings of three researchers who observed distance education curricula in the environments of education, administration and health sciences to see if there was congruency in the delivery of distance education amongst those venues. The theoretical framework for the study is constructed on the principle that distance education can crossover academic and vocational disciplines to mediate with technology and provide congruence in learning. Using a qualitative approach, the authors chronicled the design, developmental and evaluative periods, triangulated their data and then compared their findings for parallels.

There have been many questions raised about the efficacy of on-line distance education, but the delivery system is still too young to assess which measurement tools are meaningful in the collection of data, let alone the long term effects of on-line course delivery (Dillon, 1996; Jurasek, 1993). Still, the advantages of availability to students who might not otherwise be able to attend "face to face" classes have been widely acknowledged (Brande, 1993). These authors investigated distance education to assess how distance education was utilized from each of their areas of expertise: education, administration, and health sciences. What each author discovered was that, beyond the similarities of technological application, there were also similarities in philosophical, communicative, and discursive practices (Gannon-Cook, 1998). Moreover, while the delivery of on-line distance education was designed to be transparent in the three environments, the interstices between technology utilization and content delivery uncovered motivational considerations that did merit further investigation within all three environments. This paper reports their observations, and also discusses how theory both supports and fails to support, distance education in the venues reviewed.

The story of distance education is a very old one, albeit the technologies of today offer distance education as being a young, innovative delivery system. Stories have been passed on of students on the Frontier getting their textbooks and courses via Pony Express (MacKenzie, Christensen & Rigby, 1968). Over the next century, distance education graduated from those mail order courses to the dujour method of communication, telephone course transmission, and on to the contemporary electronic courses delivered via television or videotape. Most recently, the newest generation of distance education has introduced us to the merits of the World Wide Web (Web); Internet, applications and these courses have been embraced and increasingly adopted by colleges, corporations and individuals around the world.

Philosophical Environments

The philosophical, also described as epistemological underpinnings, of an environment offer numerous similarities within a distance education experience. The metaphorical understanding that develops the learning environment for a learner sets the tone for the course structure and is altruistic in its attempt to aid the learner in understanding the nuances of the knowledge to be obtained. Through such a metaphorical environment, the philosophical environment may be developed and the motivation of the student is further enhanced.

Accessibility and Convenience

It is clear that accessibility and convenience are key reasons for distance education's recent surge in popularity. Demand is a key driver for so many of the distance education courses becoming available on the Internet and on Intranets of colleges and corporations. But the merits of distance education alternatives also include access and cost-effectiveness. While there are still many challenges to designing and offering distance education courses, legal and learning style issues, it seems unlikely that the trend for more distance education will abate at any time in the foreseeable future.

Discursive Environments

The environment through which discursive opportunities may develop is also of utmost importance to the distance education situation. Discussion lists, listservs, chat rooms, private electronic mails (e-mails) serve to offer not only communications between the learner and instructor as well as other learners, but further defines the educational situation. The uses of such discursive environments are found to be positive aspects of an educational environment within a traditional classroom setting and may be seen as even more important when the knowledge acquisition and understanding is taking place at a distance.

Conclusions

The emphasis upon philosophical environments, accessibility and convenience, and discursive environments can not be emphasized enough within a distance education situation. Through the careful consideration of such clearly articulated issues, future considerations will become further defined and discussions will surround the importance of these considerations.

References

Brande, L. (1993). *Flexible and distance learning*. New York: Wiley.

Dillon, A. (1996). Myths, misconceptions and an alternative view of information usage and the electronic medium. In J. Ruet et al. (Eds.), *Hypertext and Cognition*. Mahwah, NJ: Erlbaum.

Gannon-Cook, R. (1997). Going the distance. In B. Robin, D. Willis, and J. Willis (Eds.), *Technology and Teacher Education Annual 1997*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Jurasek, K. A. (1993). *Distance education via compressed video: An evaluation of the attitudes and perceptions of students and instructors*. IA: Iowa State University.

MacKenzie, O., Christensen, E. L., & Rigby, P. H. (1968). *Correspondence instruction in the United States*. New York: McGraw-Hill.

Cooperative Searching on the Internet

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Abstract: The problem of obtaining relevant information on the Internet is becoming increasingly problematic due to the rapid growth of the web. This whole picture is complicated further where it is necessary to exploit large numbers of queries in order to ferret out information on complex topics spread across multiple domains, disparate locations, and long timelines. This task is often too complex and costly for a single searcher to perform effectively.

We have addressed the problem through a prototype, which supports cooperative searching by a group of users. The main focus is on providing users with an environment that supports problem segmentation and tasking while still encouraging serendipity and collaboration. The prototype is a server-based tool for multiple users to submit queries to commercial search engines and share the information. Users can build a collection of queries for a topic in a folder and identify relevant documents. This information can be shared among all users and additional descriptive information can be included. Overall, initial results suggest that cooperative searching has advantages over single-user searching when topics are complex and large volumes of relevant information must be reviewed.

Cooperative Searching-- Research Context

Experience with actual analysts suggests that collaboration is natural for information discovery and some stages of analysis. For example, in many intelligence environments, analyst workgroups often work in close coordination to ferret out useful information, organize it and disseminate it to end-users. Workgroup activities can include tightly coupled, synchronous shared analysis activities (e.g., team rooms) as well as loosely coordinated, asynchronous searching using automated search technology, Grudin [1]. Overall, although collaboration exists amongst workgroups addressing a specific problem, it is largely unsupported by current work environments. In particular, users often have little sense of what colleagues are searching for at any given time and, similarly, have little insight into what knowledge has been gained.

Cooperative searching is easily motivated given the complexity of many search tasks, the volume of information available, and the range of queries needed to provide reasonable coverage on a topic space. This overall complexity makes single-threaded analysis problematic. In some sense, cooperative searching provides a sort of parallelism that allows users to adjust or distribute workloads, combine complementary search strategies, and to corroborate relevance findings -- all working within a problem or group context. Many of the systemic issues central to effective collaboration have been addressed early on by Swanson [2] and more recently by Twidale & Nichols [3], and others. However, current retrieval technology is essentially designed for single use and does not support collaborative work directly.

The core research will be to identify effective automatic approaches for combining evidence (e.g., relevance judgements) from multiple users as the basis for generating a "relevance" context or map that can support query generation, query refinement, and topic categorization. There is an extensive literature on query generation/evaluation [e.g., 4,5] and relevance feedback [6,7]. However, the overall focus has been on single user environments and generally resulted in "simple" (e.g., binary) relevance assessments. With cooperative searching the relevance feedback model may involve multiple feedback loops containing information from various search and analysis contexts. Overall, the core research is focused on what we call the Cooperative Search Hypothesis:

The Cooperative Search Hypothesis holds if successive retrieval iterations exploiting a shared (or group) relevance context show improved performance (e.g., precision/recall) over incremental searching that has no memory (i.e., that lacks a global relevance context to draw on).

The General Model

Work is organized around projects or tasks. Each project has a shared workspace used to manage users, queries, documents, and associated metadata to include document ratings, and annotations. In addition, each project workspace is mapped to a global context that supports referrals to related users and queries.

The underlying computational framework has four main components-- automated collection using multiple search engines and link traversal methods; organization based on URL analysis; clustering and offline classification, user-specified web page monitoring; and end-user annotation and communication.

Lessons Learned

We have just begun to formalize testing with the initial version of the system, however early work with small user groups contributed much to the current design. Some selective observations follow:

- Although most users felt the cooperative search user's interface provided an overall more effective environment for searching and analysis, some users preferred to use special features of specific search engines (e.g., AltaVista) directly.
- Although users preferred interactive searching and results review; many distributed the bulk of their analysis effort (reading, assessment, annotation, distribution) across several days.
- Folder caches, containing group-rated relevant items, were found useful in characterizing the overall topic and in generating an output report for dissemination to consumers.
- Users effectively used the integrated email to forward analysis (with attached search results) to members of the group or to targeted consumers while working within the folder workspace. This directly supported notification and sharing.
- Search teams wanted tools to reduce the amount of overlapping work performed across the group.

Conclusions

We have described a collaborative tool, which can be used by a group to research a topic on the Internet. The tool eliminates duplicate searches, partitions the task of locating relevant information, and provides a peer review based approach to identifying key sources of information. This tool provides functions not currently available in commercial products. Further testing with users and research experiments focused on effective methods for combining multi-user relevance judgements are planned for the next phase of work.

References

1. Grudin, J. (1994). "Computer-supported cooperative work: its history and participation." Computer 27(5): 19-26.
2. Swanson, D. R. (1964). "Dialogues with a catalog." Library Quarterly 34: 113-125
3. Michael B. Twidale and David M. Nichols, A Survey of Applications of CSCW for Digital Libraries, Technical Report CSEG/4/98, Computing Department, Lancaster University
4. Graefe, G., Query Evaluation Techniques for Large Databases, ACM Computing Surveys, 25(2), 73-170, 1993.
5. Spink, Amanda; Wilson, Tom ; Ellis, David; Ford, Nigel, Users' Successive Searches in Digital Environments, D-Lib Magazine, April 1998
6. Schamber, L., Human Behavior and Relevance. Annual Review of Information Science and Technology, 29:1-33, 1994.
7. Bateman, J., Modeling Changes in Relevance Criteria: An Information Seeking Study. Unpublished Dissertation. School of Library and Information Sciences, University of North Texas, 1998.
8. Konchady M. and D'Amore R., Efficient Searching, Analysis, and Visualization of Internet Data, WebNet 98' Orlando, Fl.

Garfinkel S. and Spafford G., Practical UNIX and Internet Security, O'Reilly & Associates, Inc.,

Tibetan Bonpo Refugee Clergy Use Digital Media Archive to Preserve Indigenous Religion

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Abstract - The Tibetan Bonpo Media Archive, a digital archive project, is in the University of Colorado's Norlin Library Human Right's Archive. Using video as primary research material, the Archive has over 100 hours of footage, 1500 photographs, and 27 hours of digital audio of the pre-Buddhist indigenous Tibetan Bonpo. The goal of the project to have scholars and visitors to Bon sites share their media in the Archive. A sister Library is being established in Dolanji, India at the only fully accredited Bonpo teaching monastery in existence. As the project grows, sacred texts in Dolanji will be digitized for preservation and duplication. Materials will be available on the WorldWideWeb. Cyberspace holds the potential to be their cultural treasure trove.

I a. Methodology for the Tibetan Bonpo Media Archive Project

The Bonpo Media Archive Project documents theseTibetan indigenous people, 750,000 live in China, 1000 refugees in India and Nepal, with only 180 fully educated monks. That a digital archive is the best hope for their cultural survival tells us something about the technology, culture, and times in 1999. One of the oldest religions in the world, it has survived via dialectics, sacred art and ritual. This project adapts media technology to support existing methods the monks use for cultural communication. To the Bon whose religious worldview is seamlessly enmeshed in their symbols, ritual practice, and geographical sites - preserving ritual, song, and holy sites in digital media is an adaptation to fragmented modern life. To the Bon, the knowledge essential to preserve is that required to comprehend transcendent "Objective" reality. The Bonpo do not base their beliefs on science, but on religious constructs. They have their own ideology and reasoning techniques.

The Media Archive Project uses electronically mediated forms of communication to shape cultural identity for today's Bonpo. The project has five phases: 1.] The principal investigator shot digital video and trained a monk to shoot while in China; 2.] A monk visited the Boulder campus to catalogue and translate visual material. He learned digital editing, and archiving techniques. 3.] Further fieldwork reliant on the monks shooting; 4.] Creation of dvd's, video, and interactive web-based archive. 5.] Study how the media is employed in India and Nepal, and the cultural result.

Ib. Collaborative Bon Project for Indigenous Media

The guidelines for the Bonpo Media Archive Project that can be used in collaborative indigenous media projects: 1. Outside involvement by invitation; 2. The Bonpo select the subject matter; 3. The leadership learn what could be captured on video; 4. Training local people on site; 5. Obtain equipment, in this instance, a video camera; 6. Ongoing input from Indigenous knowledge-based expert; 7. Interactive teaching and learning style; 8. Indigenous Demand for Dissemination of Information: since living in exile, they've been housing copies of texts in libraries, including the Library of Congress. Now they can use a video archive; 9. Experiential Learning: Video allows for a visceral experience.

The Bon have relied on visual artifacts for thousands of years. They search for tools to maintain cultural continuity and now use modern means to preserve their indigenous knowledge base. This is a culture where people are the purveyors of information rather than technology. Their reality incorporates the possibilities of divine intervention, magic, and telepathic communication. They comment that electronic media is a powerful tool, but trivial compared to the potential of the human mind. They have easily accepted working in multiple mediums.

II. a. History & Context:

BEST COPY AVAILABLE

The Web provides new opportunities for cross-cultural communication via continuous access to cyberspace. There has been a concurrent evolution of thinking, where a "native" media is evolving in which the subject is the object, as in the dominant mass media. Traditional indigenous artists are adding electronic media to their toolkit. An entire generation of indigenous media makers has arisen in the past fifteen years. In teaching the Bon monks how to use media technology we don't impose methods, but allow the Bon to decide what is taped, how, how it is edited and used. The Project is undertaken to explore how they share meaning through creation of media. Using Western media represents a hope for permanence of their culture which otherwise could be lost forever. The use of technologically mediated communication is one, if not the only chance of survival. Ginsburg reminds us that:

> *"Work being produced by indigenous people about themselves is also concerned with mediating across boundaries, but they are directed to the mediation of ruptures of time and history. They work to heal disruptions in cultural knowledge, in historical memory, and in identity between generations occasioned by the tragic but familiar litany of assaults: the taking of lands, political violence, introduced diseases, expansion of capitalist interests and tourism, and unemployment coupled with loss of traditional bases of subsistence."* [Ginsburg 1995: 265]

The Bonpo Media Archive Project extends the sharing of information, as an insufficient number of trained monks exist, unable to service the population within Tibet, Nepal, Bhutan, and India. Digital media extends their ability to teach. The Project extends their culture's collective memory with visual records using the technological means available. The lamas are masters at creating meaning through ritual objects, performance and holy sites. The objects are gateways and metaphors pointing to their epistemological Truth, not the meaning or the truth itself. So too, they determined, can mediated images contribute to their symbolic representations. This project serves as a model for other refugee groups awash in the world today.

2b. The Bonpo Media Archive Project helps:

1 The only monastery with the full curricula needed to educate monks; 2. The new generation of refugee monks born outside of Tibet, 3. Solicit support from Westerners; 4. Extends the knowledge of Bon living masters.

The Archive provides a store of media available to assemble educational materials. Structurally, the monastic system served to preserve Bon teachings by housing sacred texts, ritual objects and teaching ceremony. Video is accepted as a natural tool of their work, capturing in symbolic form their icons of Truth. A student monk dedicated to the Archive Project has been trained in digital post-production. The first short video edited jointly by the monk and the professor was a biography of the Bon religious leader using video and old photographs with an English narration. The monk edited 4.5 hours of video with Tibetan narration.

2c. A Digital Cyberworld for Religion, The Promise of Interactive Non-linear Media for the Indigenous

Webcasting can be used to unite those in the Diaspora. Collecting information in remote location, the media can then be 'harvested' in a variety of ways. For theorists and researchers, like David Tomas (1993), cyberspace would be nothing more than a 'waste of space' if it did not become the site of new communities that offer significant cultural promise. The media that the Bonpo monks wish to make public will be posted on the Web to become part of this growing multicultural resource.

The Bonpo use many forms to teach - thangkas, stuphas, music, dance, flour figures, handwritten texts, and now, computers, and video. How does form influence content? *"In a computer based education system it will no longer be a matter of information; it will be a matter of doing it. The essence will be making it as you go and changing it as you want."* [Spender 1995: xxxiii] The Archive Project has the Bon evaluate media's impact on content. It is in the potential of cyberspace that the Bonpo Media Archive Project, rich with their knowledge, keep their culture alive.

References

Ginsburg, Faye. (1994.) embedded aesthetics: creating a discursive space for indigenous media. Cultural Anthropology 9(3) pp. 365-382.

Spender, Dale. (1995) Nattering On The Net: Women, Power, and Cyberspace. N. Melbourne: Spinifex.

Rich Web Courses at a Pauper's Price

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Abstract: Northern Arizona University Online [http://nauonline.nau.edu] has undertaken the development of highly interactive web based instruction that enhances the distributed learning experience for students. Working closely with experienced faculty, the design team creates engaging instructional media to ensure maximum student interaction with the course material. The design team has created over 70 completely web-based courses with enhanced activities from diverse disciplines in both undergraduate and graduate education.

Northern Arizona University [http://www.nau.edu] has developed an extremely cost effective system for development while maintaining a high quality and visually enticing hands-on learning environment which accommodates diverse learning styles.

NAU's system of development will be presented, along with numerous examples of interactive media from NAU courses. Attendants will be directed to online resources available to assist them in development of their own online course materials.

High Quality

Pedagogical issues are always a key faculty concern. Faculty will not embrace web-based delivery unless they see that they can provide a quality of education equal to that possible in a traditional classroom. Likewise, students demand highly interactive environments in courses delivered via the world wide web as they do in the traditional learning environment. The planning and creation of media elements is an integral part of NAU's course development. Creation of multimedia and other course content occurs simultaneously under the direction of the course instructor, ensuring high quality and seamless integration of graphics and other content.

Visually Enticing

Each web-based course developed at NAU receives a customized interface. Faculty appreciate an interface that reflects their personal taste and the essence of the course. These customized interfaces give courses a unique and expensive look for only 8-10 hours of development time. Courses within the same department share a similar style of interface, which is then customized for each course. All NAU Online courses share common elements, based on the vernacular of traditional campuses, ensuring that students only have to "learn how to learn online" once.

Hands-on Learning

Students learn by doing, and the interactive media in NAU's web-based courses ensure students are actively engaged. Whether watching film footage of racial riots from the sixties, practicing x-ray technique via shockwave movies, or viewing images of Matisse's paper cutouts or paintings by Jackson Pollock, students are exploring and interacting with the material throughout the delivery of the course.

Diverse Learning Styles

NAU Online courses reach a diverse audience worldwide. The consideration of differing learning styles is an important aspect of the development of NAU's web-based courses. Several modes of navigation have been seamlessly integrated into the courses. Students can follow a linear or hierarchical style of navigation. Hyperlinks within the course accommodate more non-linear learning – a real strength of web-based instruction. Links to external web sites bring related real world data and examples into the course and encourage students to explore additional material on the world wide web. An effort is made to include written, verbal, and image based instruction in each course. Stories and anecdotes are often presented in audio with a transcript available. A typical module of instruction might include text, audio, video, and several forms of interaction. Students are not limited to one type of presentation; they can access the same material in the format that best fits their individual preferences. The use of varying delivery methods keeps students interested and engaged while targeting multiple learning styles.

Cost Effective

The model used to develop rich and engaging web-based interactive media is extremely cost effective. Our courses are produced at a fraction of competitors' costs. Several factors allow us to create low cost engaging materials. Many graphics within the courses are created by part-time student workers hired from NAU's art programs; consequently, the students gain valuable hands-on experience in a working environment, and by using part-time workers, costs are kept low. Whenever possible, instructors assist staff in the creation of graphic materials. Often an instructor is willing to perform the basic tasks associated with graphics such as scanning images. The design team handles the more complicated steps such as retouching, colouring, or animation. Online examples and tutorials for creating media files enable interested faculty to create their own media files.

In the creation of graphics for online courses, our staff takes a modular approach. With a little forethought many scripts can be used in courses across the board. Within departments or among similar disciplines, media created for one course can be used in other courses. Sometimes the least expensive way to do something is not always the most obvious. In one case creating a QuickTimeVR™ object was $200 cheaper than scanning dozens of x-rays.

Benefits to Faculty and Students

Faculty benefit from developing online courses. Online materials developed for the web can enhance traditional classroom lectures. Students enrolled in a traditional delivery course can use web-based materials as they study the material presented. Faculty who have developed web-based courses share their enthusiasm with other instructors in their department, thus furthering integration of technology in the classroom.

Valuable learning opportunities benefit the student workers and the students who take the courses. Student workers learn to deal with clients, determine and implement the fastest and best execution of an idea, and gain valuable web authoring skills. Students enrolled in web-based courses enjoy an active and engaging learning environment where they are co-directors in their learning. Exposure to the world wide web gives students opportunities to find, evaluate, and produce material on the web. Students can learn at their own pace in a style that they prefer.

Future Exploration and Conclusion

Improved bandwidth will make engaging and interactive media more accessible to students - particularly those in outlying regions. How will the experience of web-based learning help students upon graduation?

High quality and tightly integrated interactive media in NAU's web-based courses enhances the distributed learning process and fosters inclusion of technology in the traditional classroom. Customized interfaces give courses a unique look. NAU achieves these objectives at minimal cost by using experienced student workers, following a modular approach, and choosing appropriate technologies.

An open framework for accessing resources and engineering educational tools in a virtual university

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Abstract: With the incoming of new information technologies, including the WWW environment, more and more information resources as well as learning tools are available. The problem we address in this article is to provide content, easy access to heterogeneous resources (multimedia, multiple functions ...) and customized teaching aids.

We propose the design of a global framework which enable the integration of various components with training worth, that can be selected through structured metadata. We focused more precisely on the description of teaching aids in the environmental domain and the experience we had with a simulation program in teaching courses.

1. Introduction

The first section is dedicated to the description of pedagogical contents, the second section defines the organization of pedagogical servers thanks to structured metadata and a taxonomy of concepts, then the concepts of the virtual university and its application in several places in french universities are discussed. We conclude with the future development we expect from our new educational framework.

2. Pedagogical contents

2.1 A hydrogeology simulation program

Simulation programs are computer assisted systems which aim to train young engineers for preparing, monitoring and appraising projects. The Amise simulation program is an engineering education tool designed to acquire a first experience in underground water resources management. The simulator helps the participants, grouped in teams, to generate relevant cleaning-up scenarios to solve a real case study.

Training is based on a role playing session of five days during which the teams represent environmental consultants under contract with the city of New Brighton (Minnesota, USA). After the discovery of the municipal well contamination, the team has to identify the nature and the extend of the pollution, develop a model of the local groundwater flow (using analytic elements) and design the new water supply network (wells, treatment plant and pipelines).

The Amise simulation results are used to define environmental management rules considering the impact of modeling precision throughout the decision making process.

The simulator is structured upon three majors elements types : database, data access tools and data treatment methods.

* Database

All the information used to represent reality in the simulation is stored in databases. For example, the information relative to in force standards, financial costs and waiting periods associated to working or studying phases of the project, documents on hydro-geologic conditions or on the aquifer behavior, the possible events relative to meetings between the team and the concerned institutions.

This database contains all the information concerning the extend and the nature of the pollution, contaminant concentrations and head of the aquifer covering the area of concern (1 600 points over 110 km^2).

* Database access tools

The regulation, document, and event database are organized as a WWW server(http://helios.emse.fr/~baillon/) available through the Internet (fig 1). The interface is written in HTML with some programs in Java.

* Data treatment methods

Data collected concerning the behavior of the aquifer as well as the extend and the nature of the pollution, need to be treated to obtain more information . This is done by using interpolation methods, and a validation of simplified models in a decision making process.

2.2 A geological hypermedia server

This WWW server is available at (http://mure.emse.fr/TERRIMAGES) and is composed of structured hypertext cards including images. These cards are written in a SGML format, and are accessible by various types of links. For example, the user can navigate in the geological database through hypertext links representing concepts, methodologies, or by following the hierarchy of terms given in a thesaurus or a volcanism classification. The aim of this server is to help teachers as well as students in their course preparation or training.

2.3 A sustainable development WWW server

The AGORA21 server (http://www.agora21.org) has been created to gather specialists, experts and environmental people in participating to virtual thematic forums and to be informed of the news in environment. It is aimed to be a place of debates, exchanges and information concerning the sustainable development.

3. Organization of multiple WWW servers

In the following, we consider that all servers we discussed previously are called documents because they provide information and other teaching programs which can be used by both teachers and learners.
We use metadata embedded within documents of the WWW servers in order to explicit the representation and the description of them.

Introducing metadata to describe the structure and content of WWW servers enable the author of the documents or experts to explicit the context. Metadata may explicit the internal and external organization of documents;
Through a common metadata shared by the WWW providers, one teacher can find and reuse reduced components from a WWW server to build a program session.

We use a taxonomy of concepts in order to classify the various learning components created by any teachers participating on the educational content production. This taxonomy is managed by a specialized server whose role is to index the structure and the content of the pedagogical WWW servers, and then to enable interactions with users, keeping the users's profile.

4. A global framework to enable access to pedagogical contents

We use a new architecture of systems to improve the management and the use of information educational on the WWW .
Each taxonomic server is considered as a thematic directory which can be requested to direct the right pedagogical server. It classifies the content of servers registered in the architecture and may keep a trace of the profile of learners, in order to answer better depending on their desire and competencies.
This framework is based on thematic directories whose job is to localize the knowledges and the competencies of the declared WWW servers, and to make them participate in the overall auto-evaluation process.
This open architecture enable a cooperative work among the participants : teachers as authors and appraisers, and students or learners as participants to the online learning sessions.

5. Conclusions and perspectives

We designed this architecture in response to a virtual university project, which concerns several universities in France and USA, the Lyon University, the Alpes du Sud Universities, the Ecole Nationale des Mines de Saint-Etienne, and the New Brighton university in USA.
From now, we expect three things: one is to introduce new developments, including a better steady of users by storing their traversal of HTML links, in order to direct them towards different levels or by proposing a course recall.
Second, the evaluation of on-line trainings may be done automatically and may allow a global comparison between the students in different places. Finally we expect the extension to other universities or forums in participating in this open learning.

Expliciting structural and semantic WWW links to improve information retrieval

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Abstract: This paper describes the use of the document concept in order to extract the inter-document and intra-document structure and semantics. It aims to integrate the overall structure of documents into a new Information Retrieval System on the WWW. We explain how to manipulate the structure of multimedia documents at an apt level of granularity (passages, set of HTML pages, images). Finally we propose to combine the structural and textual analysis of documents to improve the performance of the system. The user is able to manipulate several abstraction levels of information, for example documents, images, chapter dealing with one particular interest domain. The structure and content of documents are described using metadata in the XML syntax.

1. Building documents

The WWW is a hypertext graph where the nodes are HTML pages and the links are text anchors which point to another page. The type of WWW links is not explicit. In this section, we classify various types of links we can find on the WWW:
Links of structure: they represent the logical structure of a document, either the inclusion or the sequencing of parts of a document.
Links of semantic association : these links reflect a semantic association between two pages, or two concepts and are very diverse because they concern of the cognitive aspects of the author. Indeed according to case's, the winter term can make think cold, season, country etc...
Links of navigation : purely functional , they are used to physically cut out a text in a set of pages limited in volume (number of bytes). They are used for navigation between the pages, for example back link, return to the home page.
Links of references : they are used to refer pages in connection with the subject, for example the bibliographical references, or the references to similar sites, personal pages.

All of these links are often choosen by the author during the building of pages, but the HTML syntax doesn't allow to explicit them. To mitigate these problems, we consider that a document is either a part of one page, for example an image, a passage, a title..., or a set of pages. A document can be defined as a semantic unit of information, autonomous in the sense that it can be given as a response against a user request. From here, we can consider now that a WWW site is a document. This WWW site can be structured into a hierarchy of documents, one HTML page is a document itself and is composed of structured elements representing either section, paragraph, image, sound, graph called documents too. Each level in the hierarchy corresponds to a different level of granularity. We choose a tree structure of nodes for our example to be understandable, but in fact, we can have a Directed Acyclic Graph (DAG) structure. For example we can have a first organization level, composed of several domains, sub-domains and so on. Each hierarchical level represents a level of granularity, the lowest level of granularity is that of the components of the pages. This concept of granularity is significant because it intervenes in all the stages of our new information retrieval system. Indeed, during the description of the documents, our formalism makes it possible to describe documents, to express the structural or semantic relations between the documents, to adapt this description to structured pages with the HTML format (META tags) or XML (the tags are defined by the author of the pages according to certain a DTD). Thus, it is possible to explicit the various types of relations between documents, between components of various natures (multi-media like its, image, video) or of various types like paragraphs, references, summaries...
The semantics and the structure of documents as we precised previously may be done by the author of pages, manually, thanks to metadata. A classical hierarchical clustering algorithm can determine the hierarchy of

documents and provide the summary of each cluster. The first solution enable a precise control and the labeling of each representant of clusters by the author, but it requires human help. The second solution is full-automatic but the drawback is that the label are a list of keywords extracted from the documents and maybe the concepts are omitted. For a quality reason and to enable the author to control the indexing phase, we build the structured documents with the help of the author of documents or a librarian specialist.

2. Indexing of the documents

We define the context of a document as its metadata, including content, structure and attributes of its ancestors. Each document belongs to a context. Let's go back to the library example, and consider a page of a book. This page takes place in a section, within a page, within the book itself. Each level of organization of the book gives a context, from the highest level (root is the book) to the next level in the hierarchy up to the page level. We suggest to label each level of document with the subject and by the way to build a hierarchy of subjects. But an a-posteriori organization can be built according to a given attribute of the context, as for example organism, author, subject... In fact each metadata of a context may be static or dynamic. Static means that the metadata is local to the context, dynamic means that the metadata is forwarded along the tree of metadata.

From our model of documents, the indices of documents, WWW pages and components of WWW pages can be built a priori, i.e. all the values are propagated in the building of the index or a posteriori, i.e. the values are propagated at the request time. There is a balance between the two solutions in terms of index access time and volume storage optimization. For efficiency reasons the indices are built a priori.

3. Requesting documents

Let's assume that Docs is the corpus of the documents. We suppose that the modifications structure-induced have been taken into account in the creation, indexing and evaluation phase. In order to support the new functionalities we introduced in our paper, we defined a new query language that supports:

- dynamic granularity of the response, i.e. the granularity of the document (a chapter, a section, an image) is not expressed in the query but determined by the information retrieval system with the evaluation function at the request time,
- contextual requests, i.e. it is possible to specify in which context (referring to the definition of the context) the matter of request is required,
- combination of multi-typed requests allowing the system to manage requests against documents of various types.

We opt for an OQL-like syntax, and we give an example of a complex query, combining both multi-type, context and structure :

Query: find pages containing images like "image_input" dealing with pollution in the context of environment.

```
Select d from d in Docs where d.type = page AND d->subject() = 'pollution' AND d -> context() about
'environment' AND  image_input approx (select i from Docs where i.type = image AND i in d ->
descendants() AND i  ~~ image_input)
```

4. Conclusion

Classical information retrieval systems give responses in the pre-defined granularity of documents, often without taking into account neither the structure of a document nor its semantics and context. Here we explain how we can explicit the structure and the context of WWW pages, and we suggest a new information retrieval system that can index, search HTML pages organized into mutli-typed documents. This will enable end-user to request with a powerful semantic query language and to provide more suitable and contextual responses a several level of granularity. In the future we aim to organize the pages automatically and to evaluate the new information retrieval system.

Impact of Hosting a Virtual Conference on Online Facilitation and WBI Development Skills

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It is difficult to teach people to be good online courseware developers if they don't know what it is like to be on the receiving end of their designs -- either as a student or an instructor. In a graduate-level course on "Designing Web-based Instruction for Distance Education", students are involved in a number of design and development projects, in which they function as instructional designers hired to build a Web-based lesson, module, or course for a distance learning audience. Typically, students excel in (1) Web site and page layout and functionality and (2) the distribution of content and activity/project descriptions, but fail to address issues of social interaction, student collaboration, student motivation to return to the Web site over and over, etc. In fact, it is difficult for them to understand why it is necessary to focus on Web teaching and learning strategies in their roles as "WBI designers". Unfortunately, the class does not have access to pre-existing Web-based courses that they could be required to facilitate in order to gain experience in Web teaching and learning. Therefore, students are required to host a virtual conference. By hosting the virtual conference, students are exposed to the triumphs and frustrations of creating an interactive learning experience delivered via the Web.

Thus far, two Virtual Conferences have been hosted by two different groups of students: one in Fall 1997 and one in Fall 1998 (the 3rd Annual Virtual Conference will be held in Fall 1999). Comparing students' work prior to and after the Virtual Conference assignment revealed that WBI students/designers:

- moved from creating professional-looking "page turning" Web sites that simply delivered textual/graphical content to developing interactive, student-centered activities (such as games, case studies, and problem-based learning activities) for learners to work through; and
- utilized communication technologies differently: instead of simply posting discussion questions on an asynchronous threaded discussion forum for learners to respond to, both asynchronous and synchronous communication technologies (threaded discussions, reflective journals/forms, chat and whiteboard) were being used for debates, collaborative project/product development, peer teaching, and presentations.

The Virtual Conference assignment has been so effective as a learning experience for WBI designers/students -- as well as providing a good learning experience for the virtual conference participants -- that the Fall Virtual Conference is now an on-going staple of the Distance Education track of the Instructional Technology graduate program, with plans to host a virtual conference every Fall.

The Virtual Conference Assignment

For the Virtual Conference assignment, students collaboratively develop and deliver an online/virtual professional conference on various aspects of designing distance education for the WWW. Besides the actual conference, documentation (1) describing the strategies and tactics used to promote, organize, facilitate, evaluate, etc. the conference and (2) supporting the design decisions made based on front-end analysis data is required. Results of the conference are debriefed in class, and students are required to reflect on the overall experience and on what they learned from the process; their reflection was structured by an online assessment (see http://www.cudenver.edu/~jdunlap/5990/conferencejournal.htm) they helped to develop (see an example of a student's evaluation of the virtual conference experience at http://clem.mscd.edu/~woodleyx/wbi/online.htm).

Description of Student Activities

The objective of this project is for students to collaboratively develop and deliver an online/virtual professional conference covering issues related to designing distance education on the WWW. To make this happen students have to take responsibility for a number of activities and deliverables:

- As a class, students have to select five topics that represented important issues of Web-based distance education. They then have to determine who will be responsible for which topic/s. Responsibility for topics requires students to research, prepare (includes, but is not limited to, developing a Web-based presentation and/or paper), manage, and facilitate the portion of the virtual conference related to those topics. The conference runs for four days during each Fall semester; topics, activities, and facilitators have to be scheduled by the students for each day of the virtual conference.
- As a class, students have to decide what Web-based communication technologies are needed to conduct the online conference and create or contract those technologies.
- Students need to determine what strategies and tactics should be employed to ensure conference attendee participation throughout the duration of the conference. This includes lining up "guest speakers" and/or developing presentations, debates, case studies, and other engaging activities that will keep conference participants involved.
- Students also need to develop an evaluation tool so participants can let them know what they think. Students must analyze the evaluation findings to determine "lessons learned".
- Students develop and upload the conference site.
- Students promote the conference to classes, students, and faculty in the School of Education and any others deemed appropriate, and to outside educational and professional groups.
- Students are responsible for providing technical support throughout the conference.
- Students document in writing the decisions they make on the above issues.

1st and 2nd Annual Virtual Conferences: The Students' Conference Sites

There have been two virtual conferences hosted by graduate students in the "Designing Web-based Instruction for Distance Education" course:

1st Annual Virtual Conference: Instructional Strategies and Delivery Issues of Web-Based Instruction – http://carbon.cudenver.edu/~jdunlap/seminar/

2nd Annual Virtual Conference: Beyond Page Turning and Lecture Techniques: Effective Instructional Strategies for Web-based Learning Environments – http://web-education.net/fall98conf/

[**Note:** For notification of future Virtual Conferences, see http://ceo.cudenver.edu/~Joni_Dunlap/AACE/virtualexamples.html]

A Web-Based Tutoring Tool for Calculating Default Logic Extensions

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Introduction and Background

In this paper, we report on the use of a tutoring program supporting an advanced university course on knowledge-based systems for students of computer science. The course is suggested to be attended at the sixth semester and deals with both practical and theoretical issues regarding knowledge-representation techniques. In previous installments of the lecture, we noticed that certain topics caused problems in understanding among students. A particular hurdle represented the calculation of extensions in Reiter's default logic [Reiter 1980]. Reasons for this difficulties can be found in the fact that (i) the notion of an extension is defined only in a *non-constructive* fashion, and (ii) in order to check whether an object represents an extension, certain skills of formal logic are required, which most students ostensibly lacked, although an undergraduate course on mathematical logic is mandatory in their curriculum. In order to tackle this situation, we had to find a way to make the complex issues easier to comprehend, and, at the same time, provide a better motivation for the students than pure class-room teaching.

Since computer-based education is growing in popularity, and students in general enjoy applying new technologies, we decided to implement a computer program which explains the problematic topic as detailed as possible. The following items where chosen as the main specification of the program:

-it must not only visualize the computation of extensions, but also explain the required steps in detail;
-it should contain examples where the characteristics of default logic are expressed; and finally
-it should require no special software and should run on any computer.

To fulfill the third requirement, we opted to use a JAVA-applet to guarantee highest possible accessibility, because all students have access to the Web and any machine which has a JAVA-capable browser can be used to execute the program. In fact, all standard browsers claim to be JAVA-compatible and are free for non-commercial use.

The Applet

Let us first briefly sketch what the tool is actually supposed to visualize.

Default logic belongs to that class of logical formalisms devoted to the study of human common-sense reasoning, i.e., the process of inferring "plausible" conclusions given less than conclusive evidence. A characteristic instance of this sort of reasoning is the frequent approach to assert a particular statement as long as there is no evidence to the contrary. In default logic, such assertions are facilitated by special kinds of inference rules, the so-called *default rules*, stating what is expected to hold under *normal* circumstances. A *default theory*, then, is a collection of default rules, together with a set of definite facts (called the *premises* of the theory).

Since the application of a default depends on both *the presence and the absence of certain knowledge*, different defaults can be mutually blocking and hence the total knowledge induced by a given default theory can give rise to several (if any!) possible "states of affairs". These sets of total beliefs are called *extensions* of the given default theory and play a vital role in default logic.

Unfortunately, the formal definition of an extension is rather tricky and involves some intricate fixed-point construction. (N.B. A *fixed-point* of an operator T is a value x such that $T(x) = x$ holds.) However, for a wide class of default theories, a concrete generate-and-test algorithm can be given which outputs all extensions of a given default theory. Our applet now has the task to visualize this algorithm. The algorithm is as follows: in the first stage, possible candidates for being an extension are generated; and in the second stage, the candidates are checked whether they represent an extension or not.

The program itself consists of several examples to choose from; *in toto* representing characteristic properties of default logic. Each example is provided with a detailed step-by-step solution, running either automatically or manually, in which case the student clicks on a button in order to proceed to the next step. In automatic mode, the speed of the simulation can be adjusted; it can be stopped at any point and also restarted if desired.

The generation of the candidates, and the checking of the candidates are presented in an own window, respectively, and the corresponding steps are given in a structured diagram at the right-hand-side of these windows. Explanations for each step can be requested by simply clicking on the respective text, which are then displayed in a small pop-up window. Help and a general description of each example can also be requested, which will appear in a new browser window.

Responses

Generally, student response was predominately favourable. The few negative reactions all centered around he inability of the respective students to execute the program. However, such situations occurred only if the student disregarded the information we provided specifying the particular versions of the browser which guarantee a trouble-free execution of the applet. For instance, some older (intermediate) versions of Netscape for Linux exhibited certain unpleasant font-related problems, which, however, have been resolved by the current release.

The most interesting question of course was whether the program fulfills our expectation of improving the students skills and examination results. Analyzing the examinations which have been carried out since the availability of the tool, there is an affirmative answer to this question. Let us discuss this in more detail.

Before we supported the students with our tool, their knowledge and ability to generate extensions of given (simple) default theories were rather disappointing. Since we knew these deficiencies, we recapitulated the topic several times during the lectures and discussed many examples. Although we stressed the importance of these examples with respect to the examination at the end of the course, less than 50% of the students got more than 50% of the possible points in those examples concerning default logic.

Since the availability of our tool, however, there is a clear improvement over the previous situation. First of all, the number of students using the tool increased quite significantly over time (from 32% to 58% of all students performing the examination). The reason is that the tool becomes more and more tested and some inevitable software glitches have been removed. Moreover, students profiting from the tool recommend its use to other students. From a performance point of view, there is a marked difference between those students which claim usage of the tool and those either claiming non-usage or giving no answer at all. Tool users received between 8% and 16% more points on the default-logic example than non-users, and 21% more points than students not answering the question about the tool usage.

Future Issues

In the current version of the applet, the examples are hard-coded. However, the program is written in such a way that additional examples can be added without much ado, and that it allows the straightforward inclusion of a simple theorem prover, enabling users to create their own examples. In fact, currently we are working on this extension of the program, and we hope that the new version will be of even greater benefit than the current one. Also, since the concepts underlying the construction of extensions in default logic are closely related to certain semantics for logic programming with negation as failure - which represent similar problems among students - we plan to develop a related visualization tool for that area as well.

References

Reiter, R. (1980). A Logic for Default Reasoning. *Artificial Intelligence Journal*, 13, 81 - 132.

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A Manufacturing Environment for a Multimedia Courseware Curriculum

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Abstract : The development of Web-based courses has proceeded in an analogous fashion to the evolution of the craft industries of the 16th and 17th century. There have evolved pockets of skilled "tradesmen" who have produced isolated examples of state-of-the-art, multimedia courseware. Often, in a given department or college, there are a few faculty who are personally motivated to adopt Web-based education and to wholeheartedly investigate and develop courseware in their specific areas of educational specialty. Thus many educational programs have high quality examples of multimedia courseware which , unfortunately, are limited to a narrow field of specialized topics. Thus there are many examples of finely crafted Web-based courses but little evidence of concerted efforts to elevate an entire curriculum onto an Internet platform.In the 18th century, the Industrial Revolution began in Britain and had far-reaching consequences for the design and manufacture of mechanical products. The manufacturing age dramatically diminished the need for craftsmen who were replaced by a system involving the division of labor, part interchangeability and mass production methodologies. This paper describes the organization of a "manufacturing system" for an information technology curriculum in which a number of Web-based courses were built to a high standard of quality and regularity.

1. Introduction

The development of Web-based courses has proceeded in an analogous fashion to the evolution of the craft industries of the 16th and 17th century. There have evolved pockets of skilled "tradesmen" who have produced isolated examples of state-of-the-art, multimedia courseware. Often, in a given department or college, there are a few faculty who are personally motivated to adopt Web-based education and to wholeheartedly investigate and develop courseware in their specific areas of educational specialty. Thus many educational programs have high quality instances of multimedia courseware which are limited to specialized topics. Thus there are many examples of finely crafted Web-based courses but little evidence of concerted efforts to elevate an entire curriculum onto an Internet platform.

In the 18th century, the Industrial Revolution began in Britain and had far-reaching consequences for the design and manufacture of mechanical products. The manufacturing age dramatically diminished the need for craftsmen who were replaced by a system involving the division of labor, part interchangeability and mass production methodologies. This paper describes the organization of a "manufacturing system" for an information technology curriculum in which a number of Web-based courses have been built to a high standard of quality and regularity.

2.Organizing for "Production"

The techniques, which were developed and which were the subject of this paper, were in a response to the need to develop a new degree program, which would address the shortage of Information Technology (IT) professionals. The curriculum for the degree program was established in the summer of 1998 and consisted of twenty-five courses with computer science or IT content. It was decided that all twenty-five courses would be made available over the internet and would be established within a two-year time frame commencing with the Fall 1999 semester.Given the compressed time scale and the need for a consistent development methodology, it was decided to adopt a manufacturing model for the effort.A manufacturing system, in the common sense, involves making products on a large scale with division of labor. The latter concept relates to the specialization of function for the labor element of the system.

Any systematic approach to "mass production" first requires a product that is designed to fulfill it's intended function. Once established, the product is broken down into components and a process design is created which determines which "parts" should be custom made ("in-house") and which could be acquired from vendors ("bought-in"). For each part which is custom, a production plan is established which identifies the specific technical steps that will create the functional and aesthetic features of the part. This involves defining the specific manufacturing processes which will effect the part features and developing a sequence which will create the features in a logical order.

3.The Product

The design of the multimedia courseware was the cornerstone of the entire process. The desirable features of a typical course were established and this design then dictated the tools needed for its creation and the sequence of creation. The product specification was developed over a series of meetings by a committee which consisted of academic faculty ("content experts'), multimedia design specialists and network personnel. Based upon the discussions, the features of a multimedia course were defined as:

1. A Course Home Page which provided general course information and links to all other course features;
2. A Lessons Page that linked to the material covered in the course. This material was broken down into a number of topics, which would lie in a range between five and nine. Each topic would be self contained and would include the following components:
    1. Lecture slides, which would consist of key technical points, augmented with a video or audio presentation.
    2. Quizzes which would be used for student self-test and which could be used by the students to establish their comprehension of the lecture material. Although the quizzes would be evaluated, they would not be used for grading purposes.
    3. Lecture notes.
    4. Animations which were used to demonstrate the dynamics of, for example, a computer algorithm.
3. A Syllabus Page that would show the course content and its context.
4. A Calendar Page which provided the student with suggestions for self-paced study of the material and any externally imposed deadlines.
5. An Exercises Page which listed the coursework that had been assigned and which provided a central point of access for all quizzes.
6. A People Page which provided access to a chat room, personal web pages for all faculty and students and class and instructor e-mail.
7. A Resources Page that contained other web based material pertinent to the topic and a means by which students could submit URLs that they had discovered to a common archive.
8. A Downloads Page which would enable students to download zip files of the lectures.

This manufacturing process for the courseware is thus driven by this product specification.The creation of the courseware is dependent upon the selection of a suitable production plan which defines the tools and the production sequence. The various course pages may be likened to sub-assemblies which may be developed "from scratch" or may be existing components or may be vendor products.

Although there exists a large number of Web Course authoring tools, no single product could enable a satisfactory integration of the above product specification. It was therefore decided that a custom designed development environment would be used with the integration of existing vendor products.

4.The Manufacturing System

All manufacturing systems are designed to convert raw materials into saleable products. The essential raw material for multimedia courseware is naturally the course content. Two issues arose. The first concerned the determination of the specific topics to be covered in the courses. The second concerned the means by which the desired content was to be acquired and integrated into the courses. The first issue was addressed by creating a series of content committees who were charged with defining a consensus curriculum for each course. The acquisition of content was provided by employing " professional note-takers" or "gleaners" who would sit in specific classes and create course content from their notes. Such a system, provided support for the professors who may be too busy or insufficiently inclined to generate content independently.

A Dynamic Web-Based Help Desk Application

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Abstract: The Telemedicine Project Help Desk Application provides a web-based interface to a centralized help desk. The Telemedicine project uses several off-the-shelf hardware/software medical records packages, integrating them on a single workstation with extensive remote communication capabilities. When something goes wrong, the user reports the problem by entering a description of it on an HTML form. The report is stored in a database, where the help desk operators can review and assign the problem and the user can check the status of the problem being corrected.

The Telemedicine Project Help Desk Application was initially written in HTML and Java in August 1997. It runs on a Windows NT 4.0 Server system using the Netscape FastTrack web server and Java CGI applications written to the jdk1.1.3 Sun Java specification. The Telemedicine project uses several off-the-shelf hardware/software packages, integrating them on a single workstation with extensive remote communication capabilities. When something goes wrong, users often don't know what part of the system has failed. Instead of having the user call in a number of vendors to identify the problem, it is instead reported through a web interface to a centralized help desk. The help desk operators have a separate set of password protected web pages for management functions. The System Incident Reports and responses are saved to a Microsoft Access database, though any database management system with a Java database API (JDBC) could be used.

A user accessing the Help Desk application begins at the top-level web page titled 'The Navy Telemedicine Technical Help Desk'. The 'HELP DESK USER' link brings up a display showing the menu of possible user actions in one frame and a blank frame for the forms that will be displayed when an action is selected. The 'HELP DESK MANAGER' link shows the menu of manager functions and is password protected. These menu frames are the only static HTML pages in the interface. All the forms and responses are generated dynamically by Java CGI programs. When a menu action link is selected, the usual response is to run a Java program that generates an initial selection form for the user's data entry or to further qualify the selection. The forms are generated rather than static HTML so that dynamic data from the help desk database can be displayed. That way, lists of sites, equipment and engineers only need to be updated in one place in the database and they will be automatically updated in all the user interface displays. Originally, a set of Microsoft Access forms was written to maintain the database locally, but the decision was made to go to a dynamic web interface so that entries could be made by users directly instead of calling a help desk operator to enter the incident report.

For example, here is the sequence for entering a new *System Incident Report* (SIR), the most common action for a general user. When the user selects the menu item 'ADD SIR', the choice box of project site names is displayed. The user picks a site from the list and clicks the 'NEXT' button. The SIR ADD form is displayed with the site name already entered and the specific equipment data for that site in a selection list, preventing invalid site and equipment entries. The user selects the equipment and SIR priority and enters their name as the person reporting the problem and the problem description. Submitting this form starts the Java program to store the entry in the database and, if the SIR is marked 'Urgent' priority, sends a page to the Help Desk Operator.

The other actions on a SIR - assigning an engineer, adding an action, adding a resolution and displaying the SIR information - all work on a common pattern. When the user selects an action link from the menu, a Java program

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generates a table of SIRs that it is appropriate to apply the selected action to, usually the unresolved ones. The user selects an individual SIR from the table by choosing the link to that SIR ID and the form for that action is generated, containing information for the SIR requested.

The sequence of Java routines to implement these actions works as follows. The 'ADD SIR' menu item is a link to 'whichloc.bat', which calls the routine to generate the list of site names in a choice box. The title and the POST method of the form generated depend on the argument passed, controlling which action is called when the SUBMIT button of the form is clicked. This case, add, is action 1, calling 'makesir.bat'. This in turn calls 'SIR_lib.NewFormViaLocation' to generate a new SIR form, with an equipment list selected from the database for the chosen location. The POST action for this form calls givesir.bat to read the data from the form, add the new record to the database and send a page if priority is 'Urgent'. The next web page displayed to the user either confirms that the SIR was stored or reports any errors. For the actions that generate a list of possible SIRs, the link for each SIR passes two arguments to a Java routine, the SIR ID number and an action code. The program reads the data for the requested SIR from the database and generates the appropriate form for the action. The POST method calls the specific routine to store the data from the action form back into the database, either updating the SIR record or adding new records to associated tables.

The main database tables that support the system are 'Sites', 'Equipment', 'Problems', 'Problems Addressed', 'Problems Resolved', 'Engineer', and 'Engineer References'. The 'Sites' and 'Equipment' tables are referenced throughout the system. The 'Sites' table contains all the site contact information, such as the address, phone number and email address. The 'Equipment' table lists all the equipment at each site, including the vendor and dates of installation and removal, for tracking purposes. There are manager forms for adding and editing the entries in these tables over the web. The values are used for dynamic selection lists on the SIR forms. The user fills in the other fields to describe the specific problem. One of the fields is 'Priority', a toggle field that defaults to 'Regular' but can be set to 'Urgent'. Urgent problems reported trigger a canned message to be sent to the text pagers used by the helpdesk operators.

The 'Engineer' and 'Engineer References' tables are used to keep a contact list of people at the vendor sites who respond to help desk problems and to assign a specific engineer to a problem. Though many people can contribute to a solution, one person is assigned to be responsible for coordinating the work and reporting the solution back to the database. Any engineer can make entries as actions are taken to address the problem.

Monthly status reports are implemented as local database reports listing all the SIRs entered for the past month and the current status. A "current unresolved problems" report and a "new problems" report can be run at any time to see where recently reported bugs are coming from.

An additional enhancement to be considered is whether to leave the user interface as generated HTML or convert it to Java controls as well. As an assignment to practice using Java GUI controls for a Java course, I experimented with rewriting the menu displays and a couple of the forms within an applet. It is much faster to switch between the forms this way than returning to the server and generating the HTML but the test didn't include any database actions. Running as an applet under Netscape (or IE), initially limited the applet code to the version of Java the browser implemented - 1.02 for both the main browsers. JDBC was only added in Java 1.1, so even if the front end were done in Java, the database access would still have to be a CGI call to run jdk1.1, as it currently functions. I also wasn't able to make the heading and buttons look much like the current version on NT. Specific line breaks can be added to label strings and are interpreted correctly on Solaris versions of Java, but are ignored when running on NT. This prevents the headings from being laid out to match the current displays in HTML and keeps all buttons to one line of text, no matter how long it gets. Rewriting the front end as applets may be useful in the future, as Java implementations of 1.1 and 1.2 spread.

sicsDAIS: A Multi-Agent Interaction System for the Internet

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Abstract: We describe the SICS Dynamic Agent Interaction System (sicsDAIS), an agent interface management application for the Internet. It provides a unified platform for users to interact with agents. It also provides the means for agents to communicate with one another and share resources and data.

Agents provide their individual user interfaces to sicsDAIS as smaller versions of themselves, and sicsDAIS coordinates and combines the presentations of these.

1. Introduction

Agents provide a new and much needed way to view and interact with complex systems. Delegation of tasks to agents that perform without supervision and exact configuration is a powerful new mode of operation. One can expect agent services to increase in number in the near future. Agents will be accessible not only on the personal desktop or from the local network, but also from sources on the Internet.

Different agents have different responsibilities and agents can make use of one another to complete complex tasks. This new method of interaction with complex systems will perhaps at some point replace the direct manipulation for some types of applications. For most agent systems, however, a combination of delegation and direct manipulation will be needed.

Agents need to be able to interact with their users. Some configuration is necessary to convey the user's intentions and the agents also require means to present the results of their work. What happens when the user interacts with agents? How will the interaction take place? Each agent will want to present itself in the best possible way, in terms of efficiency of use as in the case of ordinary desktop applications. How will agents be made available to the user? How will the user cope with a multitude of different agents providing separate interfaces? Given that we must use agents to perform some tasks, the question then becomes, how will the user-agent interaction take place?

The contribution of this work is the design and implementation of an approach to user-agent interaction. Our proposed solution is to allow the agents to present themselves and carry on the interaction with the user through a common user interface which combines all the agents but that still allows each agent its individuality.

2. The sicsDAIS Agent Interaction System

SICS Dynamic Agent Interaction System (sicsDAIS) [Espinoza 1998] provides a framework for interaction with multiple agents in one interface. In sicsDAIS it is possible for an agent to visualize itself to allow the user to configure it or to review its results. This can be achieved in many ways, ranging from advanced anthropomorphic figures to simple configuration panels.

SicsDAIS provides display resource management and coordination as well as communication and data sharing capabilities between agents created by different sources.

An agent sends its user interface to be displayed in the user's sicsDAIS in the form of a *content handler*–a small graphical component that represents the agent. The interface of the agent will be laid out according to built-in rules regarding the placement and sizing, etc.

The content handler is dynamically loaded and created in the user's sicsDAIS with accompanying data from the agent, data that specifies visual and internal properties of the content handler. At this point, the content handler may establish contact with the agent, thus becoming an extension of sorts to the agent.

After this the user can interact with the agent through the content handler. Some of the interaction will be local to the content handler if the necessary logic and data is present in the content handler. In other cases, the content handler will convey queries to the agent. There may be several agents involved in a session with the user. They may all have content handlers active in sicsDAIS and they may each have several content handlers. Some sessions may be governed by a central coordinating agent that preprocesses presentation requests of other agents before they reach sicsDAIS and the user. In this way, the central agent controls the layout and other properties of sicsDAIS. In other cases the presentations may be of a simpler nature and sicsDAIS itself may be capable of coordinating the requests of multiple agents.

The following are additional noteworthy features:

- The agent is not transferred to the client, only the agent's interface component is transferred. It is often possible for the user to interact with only the interface component thus minimizing network use.
- New agents may be introduced at any time.
- sicsDAIS is a Java based application that also runs as an applet. This in conjunction with Java based content handlers means platform independence and global access.
- A content handler may use any means of communication and modalities when communicating with its user. It may even be invisible, as in the case of some coordination content handlers that handle the affairs of several agents belonging to a common multi-agent application. This means that it is possible to build advanced multi-modal interaction systems using sicsDAIS. It is also possible to build homogeneous applications using many agents that are controlled by an invisible content handler in sicsDAIS.
- sicsDAIS provides a blackboard like data exchange facility with on-change notification. As agents cooperate they may share data that when changed by one agent triggers a response in another agent.
- There is an event-handling mechanism in sicsDAIS that handles all events and communication between content handlers. This event system may be logged which means a content handler may use this information for feedback purposes and adaptations.
- Communication and events are based on an internal scripting language. A content handler's reactions to user input is specified using a script that may be changed on the fly by the agent. This allows content handlers to be used by different agents in different contexts.

3. Summary

SicsDAIS is a platform-independent system for user interaction with agents. It is a central point for interacting with multiple diverse agents that all use content handlers for their presentations and interaction with the user. The system is open and flexible in such a way that new agents can be introduced at run-time by dynamic loading of the agents' content handler classes, the parts of the agents that handle the interaction and presentation. SicsDAIS is useful as a general interaction/presentation component in an agent-based application environment, particularly if there are high demands on flexibility and portability.

4. References

1. Charlton, P., Chen, Y., Mamdani, E., Pitt, J., Espinoza, F., Olsson, O., Waern, A., Somers, F. (1997). Open Agent Architecture supporting Multimedia Services on Public Information Kiosks, in *Proceedings of Practical Applications of Intelligent Agents and Multi-Agent Systems*, London.

2. Espinoza, F. (1998). sicsDAIS: Managing user interaction with multiple agents. Licentiate Thesis No 98-007, Department of Computer and Systems Sciences, Stockholm University/Royal Institute of Technology, Stockholm, Sweden.

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The work on sicsDAIS was done in the ACTS project KIMSAC (Kiosk-based Integrated Multimedia Service Access for Citizens) [Charlton et al. 1997].

Virtual Seminars At The Virtual University – A Tutor's View

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Abstract: The Virtual University (VU) at the University of Hagen is an Internet-based learning environment which includes all aspects of an university. Part of the various teaching forms at the VU are the so called Virtual Seminars, i.e. seminars run completely in the Internet. This paper details our experiences regarding the qualifications and the work a typical tutor has to do for preparing and doing a virtual seminar in a net-based environment. Due to the offer of different internet-based technologies the tutor is able to enhance the quality of his seminar by picking up the right technology for the right task. From our experience we derive the set of typical tasks a tutor has to fulfill to run a virtual seminar, and the technical and communication skills he has to master. We then describe how a virtual learning environment should support the tutor in his work, and outline how this is realized in our VU system.

Introduction

The Virtual University (VU) [https://vus.fernuni-hagen.de] started as a research project with the objective to develop a technical, organizational and didactical elements to realize a university that teaches completely in the Internet. The unique feature of this VU is that it offers all functions of a university in the Internet in a integrated way. We now have two years of practical experience with 6000 students in all kinds of teaching events and types. The basic concept of the VU is to concentrate on the students view of the university. The VU integrates different teaching activities and materials, i.e. electronic courses, online exercises, practical teaching and virtual seminars. The tutors can use a set of modern internet-based technologies to rise teaching quality and success. It is also possible for the students to hold conferences between one-another, i.e. to prepare a collaborative work.

Structure of the Virtual Seminars

To understand the function of the seminar as a teaching method it is important to know some details about conventional and virtual seminars especially in distance teaching, but also in the campus university.

The typical problems of a traditional seminar are isolation of the students, discussions are time-consuming, groupwork is nearly impossible, the on-campus phase is fulfilled with presentations, less time is left for discussion. [BERK97]. The objective of a virtual seminar is similar to traditional seminars: students have to work out and to present contributions which they had to compile and prepare in a scientific manner. For this purpose, different Internet-Services were individually combined for different seminar phases. There are also mixed forms between virtual and conventional seminars, which means only certain seminar phases are assisted by Internet-based tools while those other phases are done as in the conventional seminar.

Since the beginning of the VU project about six virtual seminars have taken place.

The virtual seminars as we conduct them in our virtual teaching environment are structured in three main phases (numbering does not represent time-line, all sub-phases are parallel processes):

1. Preparation: In this phase the tutor organizes and configures any necessary resource, based on his time and organizational plan.
2. Elaboration: During this phase the participants are provided with the material and software the tutor prepared for them. Moreover, the students can use this and do their own literature research to accomplish their contributions. Meanwhile, the students and the tutor can use the provided communication mechanisms to discuss and solve problems.
3. Conclusion: The seminar ends with the public presentation and closing discussion of their contributions. The tutor acknowledges the acceptable works and presentations and prepares the certificates for successful participation at the seminar. Often, all acceptable contributions are collected in a special seminar booklet to be distributed to the participants and to be archived in the department's library. The following functional resources

can be used in the VU: FTP-Server, NetNews-Server, Mail-Server, Videoconference-Server, Chat-Server. With these services, the tutor can establish communication channels between his students and himself, can give them his prepared material, run discussions and moderate them. The tutor has to fulfill a lot of different skills, technical and communication skills. For this a system support eases the tutors' work. The following chapter shows the way the VU supports the tutor.

System support for the Tutor

To use necessary and/or useful services for their virtual seminar, the tutor normally has to know: 1) what services are provided in the system, 2) what these services can do for, 3) how they can configure them for their own needs if possible. The success of a virtual seminar, both in the organizational and the pedagogical area, depends on the correct use of the right techniques and services. For this reason, the VU has developed a network of system support in different ways to help the tutor in his courses, especially in his virtual seminars. So, even inexperienced tutors can conduct virtual seminars and concentrate on the organizational and pedagogical issues of the seminar while reducing the technical requirements as much as possible. The main support areas are:
1. Technology: direct contact per e-mail, phone and even personally to those persons who are responsible for the configuration and administration of the communication services, especially the NetNews-Server, the Mail-Server, the Chat-Server and the Videoconferencing-Server. The tutors are given the option to administer their own service areas. 2. Tools: The system provides its own tools to create and publish content by the tutor.
3. Know How: All services and functions the VU system provides are described online. The information system provides online tutorials for every tutor, showing the use of those services by example. The system integrates its own internal news system, which is used to inform every user (especially the tutors) about changes in the system. This support element solves the problem in making the services and their usability known to the tutors.

Summary and Prospects

The experiences made with virtual seminars in the project VU are mostly positive. A users survey of participants of the VU in spring 1998 [Mitt98] showed, that the intensity of the contacts and the building of work and learning groups were rising in virtual seminars. In contrast to conventional seminars a continuing learning process is now possible, the discussions, taking place in the Internet are much more structured and disciplined than in the conventional seminars presence phase. By working out the seminar contributions in HTML it is for the first time possible to have seminar contributions as a homogenous hypertext, to avoid overlapping of topics and learn from each other's contribution. The successive publishing of the contributions enables the student to discuss continuously about certain topics, in contrast to discuss all contributions at one time. Due to the didactical approach virtual seminars follow and realize by integrating certain technological services (i.e. communication tools) the tutor's role changes from the mere teacher to a moderator and counselor for the students. To enable less experienced tutors to follow this change of role and to elaborate a virtual seminar the VU System has to implement appropriate support. What the tutor should consider: Critical for the success of a virtual seminar is the moderation process. It is necessary to look regularly in the seminar newsgroup, to read daily emails, to bundle frequently asked questions and to answer the students' questions quickly. The seminar themes should be clearly structured and the tutor should give support for the literature research and the outline of the contribution (even if the contribution should have the HTML-format). It is useful to guide from beginning on the cooperation process to have a look at the students communication styles and topics.

References

[Berkel et al. 97]
Berkel, T., Mittrach, S., Schlageter G (1997). *Internet Technologies for Teleteaching - Report on an Internet-based Seminar in the Virtual University*. International Conference on Computers in Education (ICDE) 1997, Malaysia.
[Mittrach et al. 98]
Mittrach, S. (1998). *Lehren und Lernen in der Virtuellen Universität: Konzepte, Erfahrungen, Evaluation*. FernUniversität Hagen.

User Interface Requirements in Educational Multimedia

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Introduction

The paper on the user interface requirements in educational multimedia commences with a review of the research on the use of navigational software in investigating navigational behaviour. This work has produced individual user paths in multimedia packages, recent empirical work is then detailed and related to the main previously classified types. The concept and component parts of an intelligent tutor are then developed, which includes elements which are important for the successful educational use of multimedia. Finally work on integrating this intelligent tutor into educational multimedia is outlined and some conclusions are brought together. The concept of an Interface Builder is introduced which links HCI work with results of users navigation and methods of learning in order to produce individualised learning schedules, which can be incorporated into multimedia.

Using navigational software to investigate navigational paths

Horney (1993) produced one of the most important research projects in terms of using software to interpret the navigational patterns which he investigates with hypertext users. He outlines the navigational patterns they use, details the links between these patterns and methods of constructing hypertext, and analyses their experiences. Horney finds eight hypertext authors and follows their routes through the software. He discovers that they were using five main types of navigational patterns which he terms Linear Traversal, Side Trip, Star, Extended Star and Chaotic. Mischanuk and Schwier's (1992) work on the use of audit trails in interactive hypermedia is also very helpful. Each screen that the user visits is recorded into an audit trail and these trials can then be used to investigate issues such as the number of repeat visits, how long the user spent on certain sections and their actual paths. They find four potential types of audit trails, linear, classic feedback loop branching, learner controlled parallel path branching and multimedia/ hypermedia but significantly also suggests that these are often combined by the user within each package. Canter, Rivers and Storrs (1985) use interactive databases to discover indices to characterise individual users search sequences. They then propose that these indices could be used for functions such as defining methods of searching such as browsing and scanning. Canter et al believe that users are already aware of how to navigate through concrete environments, such as a city that they are already familiar with, and in navigating data, and they explore whether or not there is an analogy in the psychological processes involved. All the users appear to follow a certain path, although as there are few choices available this is not surprising and it should be noted that true options of choice and user preferences can only be recognised if there is totally free movement within the resource. They then develop six indices (pathiness, ringiness, loopiness, spikiness, NV/NT and NV/NS. Later research by Canter (1986) investigates users navigational strategies and the implications for navigation when using different control options or front. They look at three different categories of front ends, namely command selection, menu selection and natural language techniques. They suggest that a good command of the instruction set (as in the command selection option) can allow users, especially if experienced, an ability to navigate rapidly. The results showed that once a successful method of searching the database had been discovered the user adopted this method to the exclusion of all the others. Arents and Bogaerts (1993) have been looking at intentional navigation and in particular at what kind of reader is navigating (i.e. which level), what kind of task he is performing (purpose) and what kind of information he is looking at (content).

Classification of navigation patterns from empirical work

Recent empirical work on a series of subjects revealed a distinct set of navigational patterns that each user employs. Each of the potential navigation routes e.g. linear have been investigated in turn and all the different methods of using these, recognised during the empirical work have been detailed below. The list under each of the main nine types gives an indication of whether or not it is one way or two way and how each pattern within the type differs from each other. Some of these variations or alternative ways of using the patterns were not specifically recognised from the pilot study but were potential variations which users could chose to employ and hence have been included in this list. The first two types, linear and circular are fairly self explanatory, although the early stages of the circular pattern can initially be classified as linear if sufficient of the arc or circle is complete. The star pattern in my classification implies a change in level to the next level down in the package. The hierarchical and hierarchical extra patterns can be differentiated by differences in both depth and width as the extra extension may involve more than one tree structure, while the hierarchical pattern itself is usually confined to one tree structure. The complex patterns are the most difficult to both recognise and analyse as these may be hybrid forms or simply a mixture of others or very rapid use of other patterns.

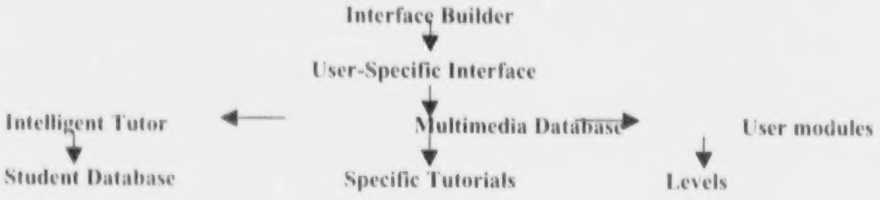
1 Linear
2 Linear extra
3 Circular
4 Star
5 Star extra
6 Hierarchical
7 Hierarchical - Extra
8 Complex - Chaotic
9 Complex - Planned

Work on intelligent tutor systems

The concept of an intelligent tutor system has been developed from the empirical work.
History - Each user, Where been, where left, relate to groups, work completed, grades link to games packages
Navigational Routes - Preferred methods, introduction and available routes, Best route, amalgamation of others, tutor's route, Perceived best route matrix , Links where to go next for student, Most successful method, Previous methods
Tutor/ teacher -Record of student achievement, Completed work/ grade
Each student's route, Most popular route links to most successful, Previous use of computers/ mm
Student level - where start/ progression, Assessment of student preferred learning methods - styles
Learning system - Problem areas/redundant/ unused - Tasks - ability levels, Where to go next
Complexity levels - higher ability/ basic level, Difficult to understand/ too easy
Individual - Portfolio/ knowledge of routes/ Problems, Specialised knowledge of own preferences
Areas that need repeating/ Strengthening exercises Extending/ higher exercises -Ways of extending/ improving coursework, Pointers to ways of improving/ gaining better assessments
Issues - Node/Screen identification, Classification of paths, Problem of dead ends, History info - separate resource, Links between users, Security - across student body, confidentiality

Creating an individualised interface

The concepts outlined in the intelligent tutor requirements above can be placed into a sequence of component parts of an adaptable interface. The interface builder requests information from the user on subjects such as their abilities and multimedia usage, novice to expert skills, previous use of computers etc. This then builds a user specific interface which can be different for each application or can retain the same major elements or appearance. This then links into the intelligent tutor with information on each student and at least some of the aspects above. The central component is the multimedia database which can be of a different composition each time or for a body of work. Other modules can also be linked in such as student databases, tutorials, user modules, levels guides etc, which can be unique or generalised.



Conclusions

Research by O'Malley (1989) states that 'the interface is the only way in which the user can operate in the represented world' and more importantly for multimedia 'if it is designed appropriately the interface becomes transparent and no longer exists for the user'. If multimedia developers are aware of how users navigate through systems and their preferred ways of learning, it is then possible to create individualised interfaces for each student. The simplicity of this system and the re-usability of its component parts should make the effort required to produce it worthwhile. Developments of this work are still being undertaken and a shell system will be constructed based on these outlines. The component parts such as the student database can then be re-used and could be applicable across a wide range of multimedia resource banks.

References

Arents, H & Bogaerts, W (1993) Navigation without links and Nodes without contents: Intensional navigation in a third-order hypermedia system. *Hypermedia*, 5, 3, 187 - 204
Barab, S, Fajen, B, Kulikowich, Young, M (1996) Assessing hypermedia navigation through pathfinder: Prospects and Limitations. *J. Educational Computing Research*. Vol 15(3) 185-205
Canter, D, Rivers, R and Storrs, G (1985) Characterizing user navigation through complex data structures. *Behav. Information Technology* 4, 17-41
Horney, M (1993) Case studies of Navigational Patterns in Constructive Hypertext *Computers in Education*. Vol 20 No 3, 257-270

Misanchuk, E & Schwier, R (1992) Representing Interactive Multimedia and Hypermedia Audit Trails *J. of Educational Multimedia and Hypermedia* 1, 355 -372

Going on a WebQuest with 'At Risk' Adult Learners

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Abstract: This paper describes 'At Risk' adult learners participating in a WebQuest about recent scientific cloning discoveries. Overall, participating students from two classes showed highly positive responses to the cloning WebQuest.

1. Introduction

It's the year of the clone! First we had Dolly, the original cloned sheep, then Molly (Dolly's daughter), and finally cloned cows, monkeys, and mice. Will humans be next? Cloning technology will soon touch the lives of everyone in society, very much as it enticed thirty 'At Risk' adult learners to embark on a cloning WebQuest[1].

2. Background

This WebQuest captured the imaginations of thirty reluctant readers. These readers were transformed into a group of learners who not only understood the implications of cloning, but also made appropriate inferences about how the scientific discovery could impact not only their own lives, but society as well. Although the concept of cloning was initially met with some psychological resistance, these students gradually developed a genuine curiosity and, finally, knowledge.

3. Approach

The class activities began with the question "Who knows what cloning is?" The few adults who had heard of cloning volunteered what they knew as others listened with amazement and responded with skepticism, awe, or even disdain. A barrage of comments and questions followed, e.g.,: "What does cloning have to do with pre-collegiate reading classes? There are scientific words that don't make sense! Why would anyone care? Why use the World Wide Web? Would human clones have the same personalities?" Soon this group of thirty adult learners discovered the answers to their questions.

A group journey that began with a single question, developed further with the viewing of selected segments of two award wining films, "Jurassic Park", where dinosaurs were cloned, and, perhaps more frightening, "The Boys from Brazil", a movie about Hitler clones. In addition, these students listened to, and read, news articles about cloning legislation and ethical controversies before embarking on their WebQuest.

Using the World Wide Web for research was essential. Cloning articles were available to meet the multiple learning modalities of 'At Risk' learners, such as, World Wide Web slide shows, audios, videos, and text. Government documents on ethics and theological perspectives about cloning were read and reported to the class by the students who selected their own group participation topics and teams. The WebQuest culminated with group presentations according to the class teams' selected topics. The class teams were divided into groups of four to eight students, according to the following issues: 1. Ethics of Cloning, 2. Religious Perspectives, 3. Human Health Benefits, 4. Animal research and 5. Social Issues.

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[1] A WebQuest is an inquiry based activity designed for interactive World Wide Web exploration.

4. Findings

The survey results (16 items) showed an overall positive student response to the cloning WebQuest. The survey was completed anonymously, following the conclusion of the cloning teams class presentations (12/1/98). The majority of participating students surveyed from two different classes finished the project with highly positive attitudes toward using the World Wide Web, scientific research and the cloning WebQuest activities (N=23, 7 absent). These positive results not only reflected the students stated responses to the survey, but were also shown by their willingness to participate in the group activities and complete the assignments in a timely manner.

5. Conclusions

An 'At Risk' population, that some educators assume are not supposed to be motivated and are assumed to lack the requisite skills to engage in the scientific, moral or ethical debates about one of the most significant scientific discoveries of the 20th century, were enthusiastic participants. Finally, those who initially 'couldn't make sense of cloning' understood it, and those who 'shouldn't be interested' in it were.

If there is any doubt that the World Wide Web is an essential tool, or that reading about 'scientific discoveries' is appropriate for all learners, then the success of this WebQuest should help educators rediscover both. When 'At Risk' adults with developmental reading needs acquire the competency to discuss moral, ethical, social, and economic issues, then the challenges of educating them has begun, with one 'At Risk' adult learner at a time.

6. References

ABC News., "A Brave New World", 1998, http://www.abcnews.com/sections/science/DailyNews/cloning980723.html

Bioethics Advisory Commission.,"Cloning Human Beings", June 1997, http://bioethics.gov/pubs.html

Beardsley, Tim., "Cloning Hits The Big Time", Scientific American http://www.sciam.com/explorations/090297clone/beardsley.html

CNN Interactive., "Scientists Grow Monkeys From Cloned Embryos", March 1997, http://www.cnn.com/TECH/9703/02/monkey.monkey/

CNN Interactive., "Poll: Most Americans Say Cloning Is Wrong", March 1997, http://www.cnn.com/TECH/9703/01/clone.poll/index.html

Devitt, Terry (Ed)., Got A Copyright On Them Genes?, The Why Files, http://whyfiles.news.wisc.edu/034clone/ethics1.html

Leutwyler, Kristin, "Send In The Clones", Scientific American http://www.sciam.com/explorations/1998/072798clone/index.html

Nuthall Keith, "Hello Dolly A WebQuest", May 1999, Poway Unified School District, http://powayusd.sdcoe.k12.ca.us/dolly/main.htm

Palca, Joe., "Human Cloning Plans", January 1998, http://www.npr.org/news/health/980106.cloning.html

Roslin Institute Online, "PN99-01: Three New Lambs For Dolly", April 1999, http://www2.ri.bbsrc.ac.uk/library/press/newsrel.html

Ross, Andrew., "Dr. Frankenstein, I Presume?", February 1997, http://www.salonmagazine.com/feb97/news/news2970224.html

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A Document Model for Generating Adaptable Courseware Using Background Data

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Abstract: Today's research activities in the area of computer aided teaching and learning concentrate on the realization of systems that generally satisfy the needs of people who want to take courses of advanced training. However those systems are not appropriate for an employment as a real learning environment. Mostly they offer very limited possibilities of interaction between the users and the system, of communication (in a asynchronous as well as synchronous way), of data security and protection, and of adaptation of the system to user needs, system environment and goals. Based on two approaches that include those techniques this paper describes the ideas of gathering and using background information as well as shows a solution of making documents adaptable.

JaTeK (Java Based Teleteaching Kit)

The lack of existing online learning systems - not to meet the requirements of university studies - has led to the realization of JaTeK [Schill 98]. JaTeK is a Client/Server system that consists of a database and three main modules: The JaTeK module serves as login component to the system, server and viewer for the learning documents and as gateway (server side) and frame (client side) for the JaWoS and Javal components. Besides it is responsible for the user, group and permission management. JaWoS (Java Based Workgroup Support) allows synchronous and asynchronous communication. With Javal (Java Based Evaluation System) instructors can evaluate their teaching material. Javal offers two different tools: The form generator allows to create, to show and evaluate questionnaires. The automatic evaluation tool gives a statistical overview of the learning material usage.

CHAMELEON (Cooperative Hypermedia Adaptive MultimEdia LEarn Objects)

In existing courseware there is a lot of material in different formats. It is very difficult to combine it to homogeneous looking, platform-independent course material and to reuse it in other contextes. The main goal of the CHAMELEON project was to develop a set of reusable, adaptable, combinable and platform-independent components, called "Learn Components", that can be glued together to a homogeneous course material. We identified different types of learn components: content components (e.g. a picture with explanation), structuring components (e.g. containers for a chapter) and interactive components (e.g. a simulation). Dependent of the learner's level the system can switch between alternative learn paths with different levels of difficulty and levels of detail.

Document Model

Components with no interactive behavior can be structured in a document model. But it is not practicable to use existing document formats because they cannot express semantical conditions and relationships between contents parts. E.g. HTML seems to be too finegrained, blocks with higher semantics are needed. There must be three levels of information: The first level is called didactical level. Here didactical rules and models are expressed. The second level is called the psychological or design level where abstract presentation and design rules are coded. Part of the third level, the content level, are the content components. We want to use XML (eXtensible Markup Language) [Harold 98] as base for our document model. The goal is to develop a grammar for "TeachML", a markup language for courseware documents.

XML documents do not know, how to present themselves to the user. XSL (eXtensible Style Language) documents map an XML document structure to a presentation format, in the simplest case to HTML. The main ad-

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vantage is the separation of the document's content and structure from its presentation. We will develop a set of XSL styles for presenting TeachML documents in different ways, e.g. as script, or (online) presentation.
In order to adapt a TeachML document to the learner it must be dynamically generated dependent on the learner's knowledge, his aims and actual success. So TeachML components are stored in an object-oriented database using DOM (Document Object Model) and dynamically glued together to a course document. A document generator selects the matching TeachML parts and creates valid courseware documents.

Background Data Model

Understanding of Background Data/Background Information (BD/BI)

Outgoing from the described document model and the Javal component it has been shown that a series of applications and tools have a constant requisition of access to so called background data or background information (BD/BI). BD/BI is data that will *not* be used for explicit presentation in a learning environment. Instead it acts directly on the process of creating the different documents. BD/BI comes from different applications and tools and can be requested from these applications whereas the requested information must not necessarily come from the same application. There are different kinds of BD/BI in learning environments, e.g. system infrastructure, course properties, application properties, precognition of the students, concrete learning progress, user behavior or concrete user actions. BD/BI can be categorized by the following criteria: *stability* (permanent, changeable permanent and dynamic), *visibility* (system-global, course-global, session-global, application specific, and user specific), and the *involved entities* (tutors, students, server and client components, network and database).
BD/BI is being generated either automatically or by user input. Automatic data gathering should be produced parallel to the user's working process without annoying him with performance decreasing or other perceivable actions. This information is stored in the BD/BI repository in a applicative way. At request of an access-permitted application the needed BD/BI will be converted into a suitable format and made available.

Concrete Applications using BD/BI

At this point we demonstrate our idea by means of 3 examples of applications generating and using BD/BI:
Document Adaptation and Generation: The main application in a learning environment that should have access to BD/BI is the document generation itself. Here the document model of CHAMELEON and the background model of JaTeK will be combined.
The document generator requests BD/BI that concerns both system conditions on server, network, and client side and user information. With user information it are meant precognition, target group, aim of the learner, wishes of the learner, skills, communication goals of the content provider, and learning progress information etc. Based on this information the document will be put together to one multimedia document using the described document model. User actions on the documents are being recorded and sent to the BD/BI repository.
Evaluation of Course Material: In a real "face-to-face" learning environment the tutor has the possibility to get feedback of his demonstrations by discussing problems, getting questions and observing reactions. In computer based learning environments this has to be realized by other mechanisms, e.g. to keep track of the accesses, the access duration and the actions on the course material. Those data will be stored as background information and made available to the evaluation application.
Prefetching of Course Material is the process of loading data to the student's/tutor's computer in advance e.g. to save telecommunication costs. Thereby data can be transferred to the student's computer in cost-efficient times. E.g. in the case of a low-speed network connection to the learning server where users usually have to wait some time for the requested multimedia documents the system requests information from the BD/BI application which material is most likely to be wanted next. This one kept track of the user action and has to decide from this and other factors which data it passes to the prefetching application.

References

[Schill 98] Schill, A., & Franze, K., & Neumann O. (1998). *Internet-Based Telelearning: Architectural Support and Experiences*. Proceedings of the ED-MEDIA & ED-TELECOM 98, Freiburg
[Harold 98] Harold, E.R. (1998). *XML: Extensible Markup Language*. IDG Books Worldwide, Inc.

Large-Scale, Web-based Learning: Opportunities for Enterprise Modeling and Decision-Making

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Abstract: The computer supported learning system (CSL) is a web-based teaching and learning resource administration system, developed by the Business Education On-Line Unit of the School of Business, at the University of Auckland, New Zealand. This paper describes CSL, discusses the pitfalls of multiple systems, platforms and administration. It discusses the potential and realised benefits to the user and the University of Auckland, in New Zealand.

Introduction

The need to maintain and provide ubiquitous and individualized teaching and learning support for staff and students is a growing concern for all tertiary education institutions. This paper looks at the school of Business' (University of Auckland) efforts to address these issues.

The computer supported learning system (CSL) operating at the University of Auckland, or Cecil as we call it, has been developed over a four year period by the Business Education on-line unit of the School of Business. It is a system that enables delivery of teaching assessment and class administration to occur in one environment. In the 1999 academic year Cecil will provide support for approximately 835 papers (classes) and be used by 240 general staff and academics in the School of Business alone. The take up and use of the system is becoming wide spread and it is predicted that Cecil will contain the entire enrolment of the university by the end of the year. In terms of paper (class)-enrolments it can support more than 100,000 students.

This year our web site will be one of the busiest in New Zealand. In 1999 we expect more than two million hits per week and have already serviced more than 350 hits per second. It is a 24 hours a day, 7 days a week operation professionally managed by the university's technology center. A more detailed discussion of the CSL system is described next.

What is Computer Supported Learning at Auckland University?

Cecil is primarily an instructional management and assessment system. It allows instructors to store and organize all of their teaching and research materials in one location and then assign these resources to individual papers. In this sense it becomes a personal body of knowledge (BoK) that can be shared with colleagues and with students. The architecture of Cecil is designed to replicate the BoK from the academic's desktop to the university system and then on to the student's laptop.

As an assessment system Cecil supports instruction by storing large banks of questions and then selecting from these banks, questions that meet the instructor's instructional objectives. The questions form an assessment that is presented to the student via the Internet either under supervised or non-supervised conditions. Assessments are immediately scored and the feedback is provided using a protocol established by the instructor. Cecil has been designed for computer-automated testing (CAT). CAT will adjust the difficulty of the following questions based upon the responses provided by the student.

Self-assessment activities are one of the most popular options. Students use Cecil at all hours to check their understanding of the learning materials. The fact that no academic credit might be obtained for doing a self-assessment seems irrelevant so long as the learning content is clearly mapped to the course objectives and examinations.

Cecil has enabled students to complete their studies in an efficient manner and papers to be managed in several ways. Students are able to access all course details and materials via the web either on or off campus. Announcements previously put on bulletin boards or made at the beginning of lectures are now made electronically making changes to programs or important message transfer very effective. Management of papers through Cecil is extremely flexible; academics and tutors can access the system, post announcement, upload materials and use Gradebook features from the web, therefore enhancing the overall-working environment. It has been noted that professors visiting in Europe can instantly inform all their students of the latest developments and tutors regularly mark assignments at home and post the marks via their internet connection. Gradebook has many unique features for paper management techniques and also advanced statistical summary facilities.

As well as a teaching and learning facilitation suite, CSL also has strong implications for data security, administration and data mining. These implications are discussed next.

Enterprise-wide Decision Making

From a management information systems (MIS) perspective the term "enterprise" means a perspective that includes a consideration of all of the organisational units, functions, processes and data elements (Laudon and Laudon, 1997)

A number of systems, similar to Cecil are on public offer to academics and their departments. Very few of these systems have been adopted on a School-wide basis and then exploited for their enterprise wide benefits. The installation of a stable user friendly system may facilitate more than the collation of marks and the provision of feedback to students, it enables the closer collaboration of staff at any scale within the organization.

Historically the need to provide a working solution to problems has lead individuals to purchase and administer their own systems. Often the implementation and administration of these systems have been subject to several pitfalls. Given the need to make best use of the equipment currently available software and hardware may be implemented in a non-standard fashion. Whilst the individual implementation may be sound there are increasing security risks associated with the proliferation of these systems. These risks may over time compromise the organisation's information systems security and the privacy of the client's data. Simple and essential functions such as backups and thorough administration may be unavailable luxuries for the individual's system. The short-term reliance of these systems also on one or two staff to provide maintenance will become a longer-term liability as the consequence of staff departure become apparent.

These issues can be addressed, in many universities compromise and compound systems have been forged. The inability to share and transfer data and teaching resources between administrative units and departments is, however, a major loss. This must be measured both in terms of the costs incurred in data translation and duplication and the frustrating time loss each finds at differing places of the system. A recipe for chaos and data corruption is apparent (Mensching J. R. and Adams D. A. 1991).

Given these hazards an enterprise solution has been developed. A dedicated team of developers and support staff enable the continuing success of Cecil as well as allowing assessment and resource management. But CSL gives more. CSL has the ability to facilitate the professor and administrative units to mine the statistical data stored within its database. Such data mining may be used to gauge the performance of a cohort of students, or look at the effect of changes in teaching and learning both in present and trend analysis (Dhar and Stein 1997 and Turban and Aronson 1998).

Conclusions

This paper has outlined the pitfalls of individualised solutions proliferating through out a university information system. CSL provides an enterprise solution to University problems associated with the storage, collation of teaching and learning resources, administration and student learning management. It has addressed privacy and organisational issues from the outset of its construction and now provides a stable, secure school and university wide system. Additional features that enable the collation of statistical data facilitate data mining and further in-depth examination of the way papers and students perform. With the successful manner in which this system has been utilised within the School of Business at the University of Auckland, further developments are planned to expand the range and nature of support that this system affords its users.

References

Laudon, K. C. and Laudon, J. P. *Essentials of Management Information Systems: Organisation and Technology* 2nd edn., Prentice Hall International Editions

Dhar V. and Stein R. 1997. *Intelligent Decision Support Methods*, Prentice Hall.

Mensching J. R. and Adams D. A. 1991. *Managing an Information System*. Prentice Hall.

An Interactive Approach To Teaching Concrete Design

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ABSTRACT: A *modernistic* approach to the design of concrete mixtures is presented. The weight method and the absolute volume method are standardized and detailed in the specifications of the American Concrete Institute. A new educationally innovative approach is developed to make the learning and design experience of concrete mixtures easy, enjoyable, and rewarding. The capabilities of *Internet* browsers together with the *JavaScript* scripting language are used as means toward implementing the design methods. An *Internet* site is developed where the procedure of concrete mix design is outlined in a logical form. The user can navigate through the process in an orderly fashion. Tables of data related to mix design are given. Included also are pages which allow users to enter data and to calculate the weights and/or volumes of the ingredients of concrete mixtures. The entire procedure can be done using different systems of units. The highlight of this approach is the interactive nature of the technique in addition to an interesting, graphical interface.

1. Introduction

The design of concrete mixtures is a systematic task which is outlined in the specifications of the American Concrete Institute (ACI) (1). The steps that should be followed in designing a concrete mix are simplified and presented in a modernistic form in this paper. The goal to be achieved is to make the design experience interesting and enjoyable. The proposed method takes advantage of the capabilities of *Internet* browsers and the *JavaScript* scripting language, which is used to conduct simple calculations. According to the proposed method, the designer will be able to enter data from design Tables into a form to calculate different weights and volumes.

2. Procedure

A brief description of the procedure used in concrete mix design is given in the following. The user selects the main components of a concrete mixture, and enters different factors that affect the design (2). These factors are workability, consistency, strength, water/cement (w/c) ratio, durability, density, and generation of heat (Figure 1). The user can also specify the use of pozzolanic materials and/or chemical additives. These materials are used to give the concrete special characteristics such as durability, resistance to freeze and thaw, or high strength.

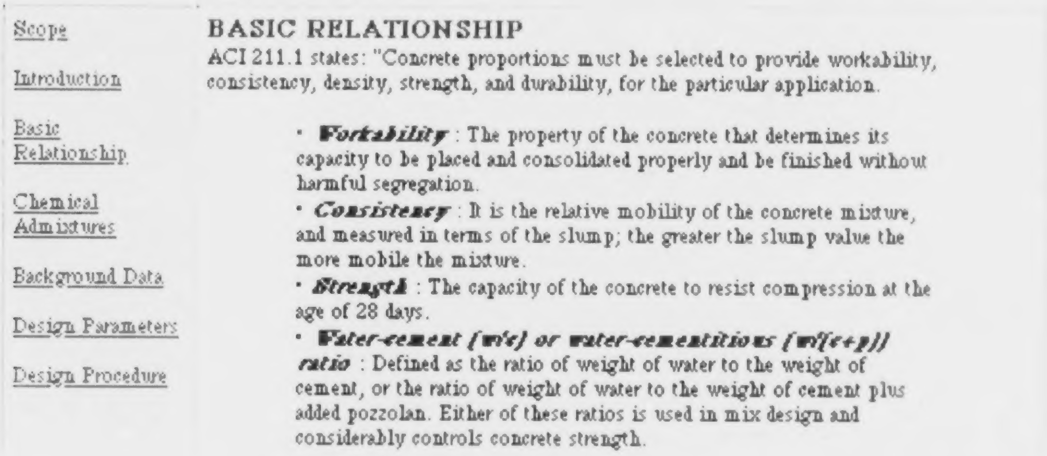
Figure 2 gives the designer different options to conduct the design procedure. Based on the selection made, the design can be conducted using the weight method or the absolute volume method. It can also be conducted using either the SI system of units or the US customary units. Mixtures can also be designed for air-entrained or non-air-entrained concrete. Depending on the selection made, the computer will branch to appropriate files where design Tables and data entry can be conducted. This step is essential and cannot be skipped.

Based on the type of the structural and concrete pouring conditions, maximum and minimum values of slump are determined. The mixing water and air content are found from design Tables. This is followed by the determination of weight of coarse aggregate (using the nominal maximum size and unit weight of aggregate), and water cement ratio. The weight of cement can then be calculated. The total weight of fresh mix is determined from design Tables. The weight of fine aggregates can be computed since the total weight of the mix and the weights of other individual ingredients are all known.

If the aggregate used in making the mix is not totally dry, adjustment for moisture content in aggregate should be made. The values of free water and the degree of absorption in both coarse and fine aggregates should be entered by the user. The options of using pozzolanic material in the mix and chemical admixtures are also available.

3. Absolute Volume Method

The design procedure described above can be conducted using the absolute volume method where volumes of different ingredients are used instead of the weights of the same. The basic difference between the two methods is the volume of air (which has no weight) is incorporated in the design. This could result in more accurate results.

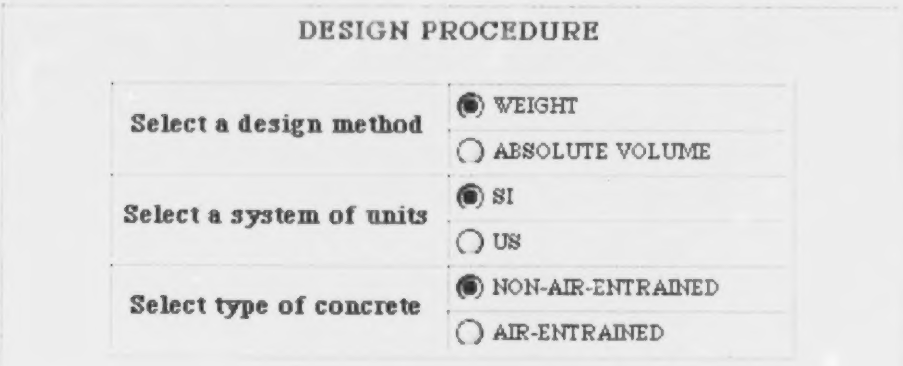


BASIC RELATIONSHIP

ACI 211.1 states: "Concrete proportions must be selected to provide workability, consistency, density, strength, and durability, for the particular application.

- ***Workability*** : The property of the concrete that determines its capacity to be placed and consolidated properly and be finished without harmful segregation.
- ***Consistency*** : It is the relative mobility of the concrete mixture, and measured in terms of the slump; the greater the slump value the more mobile the mixture.
- ***Strength*** : The capacity of the concrete to resist compression at the age of 28 days.
- ***Water-cement (w/c) or water-cementitious (w/(c+p)) ratio*** : Defined as the ratio of weight of water to the weight of cement, or the ratio of weight of water to the weight of cement plus added pozzolan. Either of these ratios is used in mix design and considerably controls concrete strength.

Figure 1: Basic relationships of ingredients used in concrete mix design.



DESIGN PROCEDURE

Select a design method	● WEIGHT
	○ ABSOLUTE VOLUME
Select a system of units	● SI
	○ US
Select type of concrete	● NON-AIR-ENTRAINED
	○ AIR-ENTRAINED

Figure 2: Options available for design procedure.

4. Reference

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American Concrete Institute (ACI) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (ACI 211.1-92, Reapproved 1996).

http://www.union.edu/PUBLIC/CERDEPT/FACULTY/GHALY/CONCRETE/

In[side]out: Art in Virtual Reality, the Museum in Virtual Space

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Abstract: The authors have created pioneering web-based and CD-ROM format electronic art since 1994. This paper describes a new artwork currently under development that will utilize virtual space in a variety of forms. The piece is titled *In[side]out* and employs a virtual hotel room as a metaphor. Viewers can navigate the room, and by doing so, explore the boundary between public and private space.

Technology is being adopted in the creation of art – the conscious use of skill and imagination to produce aesthetic work – and is resulting in new aesthetic theories and conceptions about the nature of emerging art forms. New technologies ranging from computer-mediated communications to scientific visualization and sonification are being implemented via interfaces that deliver images, sounds and other modalities of human aesthetic experience.

Emerging virtual reality technologies are particularly challenging to the contemporary art world – both practicing artists and the museum system -which is predicated on the exhibition of rare and valuable *objects*. The etiquette of engagement in the traditional museum setting, the boundaries between art and audience are in direct opposition to the inherently immersive and performative aspects of new electronic genres such as the Web, CD-ROMs, and virtual reality.

The authors have substantial experience working collaboratively to create new electronic media and have achieved considerable recognition for their work. This collaborative relationship includes the 1994 launch of *@art gallery* (www.art.uiuc.edu/@art), one of the first curated web-based art galleries to feature work produced exclusively for distribution on the World Wide Web, and the 1997 publication of *Body, Space, Memory* (BSM), the first CD-ROM artwork published by the University of Illinois Press. The @art gallery has since been recognized as a pioneer in the field of online artwork and BSM has since been shown at numerous prestigious venues worldwide, including the Centre Georges Pompidou in Paris. This work has been featured in The New York Times, the Wall Street Journal, Newsweek, and in numerous recent books on electronic art.

Our latest work, titled **In**[side]out, pushes our explorations into more immersive virtual environments. In its current form, In[side]out exists on CD-ROM and utilizes a navigable virtual space. Longer-range plans call for the development of a VRML version suitable for distribution via the World Wide Web and a full VR version implemented via a CAVE or a portable ImmersaDeck.

In[side]out is a parable about public and private space, using an anonymous hotel room as metaphor. It was originally conceived for publication in CD-ROM format, and is close to completion in that form. Consequently, much of the conceptual framework, content creation, and design work is firmly in place. Examples of the work in progress can be viewed at www.art.uiuc.edu/ncsa and will help to clarify the description below. We are currently seeking programming support and guidance in transforming the work into VRML format, as well as access to the CAVE.

Since the CD-ROM version utilizes a simple virtual space in the form of QuickTime movies, the move into VRML and VR is a logical extension of the work. Both of these media would afford the opportunity to explore avenues for combining sound, motion, still and video imagery, and text in new ways that far exceed what can be done with a two-dimensional representation.

In[side]out begins with viewers "checking-in" to a virtual hotel room, but what they soon discover is that it is still occupied by its previous guests. The relics of habitation are still present: clothes, book bags, used glasses, notes, and other evidence of everyday life. It becomes the viewer's task to unravel the mystery of these two people. Who were they? What was their relationship? Why were they together in this place?

The hotel room as privacy-for-hire sits at the boundary of public and personal life. It is a curious hybrid space that is generic and public, yet it is transformed in serial fashion into a unique and private place.

When viewers of *In[side]out* "occupy" a room that is in essence not yet vacated, they unwittingly cross the threshold into a shared space. Once in the room, they can move about and touch objects; which then tell their stories, much like the ancient concept of a "memory palace". Each object provides more information about the two former inhabitants, in the form of fragments of conversation, phone messages, personal notes, and memory vignettes.

As the story unfolds, in a different sequence for each viewer depending on their movement in the room and what they choose to interact with, the metaphor slowly shifts. Viewers come to realize that, in this space, the two former occupants were negotiating the meaning and boundaries of their own relationship. The hotel room then begins to represent the shape and limitations of that relationship. Ultimately, the audience is engaged in questions about trust, intimacy, desire, and commitment. The public/private dichotomy, which began as a question of space, is expanded to include our bodies and minds as well.

As with any work of art, regardless of era or medium, *In[side]out* engages fundamental human concerns. How is a relationship negotiated between two individuals? How do our social roles inform and inflect our many different types of relationships? How do we balance the conflicts sometimes inherent in our lives as public citizens versus our desires as private individuals? Where is the boundary between the two, and how is it established?

These kinds of human issues are particularly relevant in the late twilight of the 20th Century. Emerging digital and telecommunications technologies are themselves eroding what constitutes our private lives. Simultaneously, true public space is disappearing in some communities, with the closest approximation being the local mall. Of direct relevance is the internet itself, which exists in a gray area of its own between public and private; on the one hand a vast and nearly anonymous public space, on the other a private confessional where people sometimes feel compelled to reveal highly personal information.

In[side]out demonstrates how new technology is affecting the production of new works of art. It also points out how dramatically the delivery of artistic works by arts institutions is being altered, and how the notion of an archive is being fundamentally transfigured by changes in the physical nature of electronic art and the means by which it is displayed and stored.

Reaching Teachers Through Web-Based Distance Education

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Abstract

Technology has become ubiquitous everywhere, except in schools. Although many schools are now acquiring the technology, not enough money is being set aside for professional development of teachers in the use of technology. Consequently, teachers do not feel adequately prepared to integrate technology into their daily practice. The purpose of this study was to examine the use of the World Wide Web and electronic mail as a viable option for the professional development of K-12 educators. Two classes were investigated, one delivered using the Web and another one in a face-to-face environment. Quantitative and qualitative methods were used in this investigation. The researchers concluded that distance learning is not an education of inferior quality to those university courses taught on campus, and that classes delivered on the Web provide a viable option for professional development.

Introduction

The latter part of the twentieth century has been marked by technology changes that are increasingly affecting every aspect of human life. Technology has become ubiquitous everywhere, except in schools. Although many schools are now acquiring the technology, according to a national study conducted in 1995 by the Office of Technology Assessment (OTA), not enough money is being set aside for professional development of teachers in the use of technology. There has been little attention paid by districts to professional development needs of teachers, and Colleges of Education have not modeled its use for preservice teachers (Cuban, 1998). As a consequence, teachers do not feel adequately prepared to integrate technology into their daily practice.

The design of new professional development opportunities for teachers in the K-12 classroom is a must. In doing this we must take into account that many teachers, especially in the rural areas, have very restricted access to institutions of higher education. This situation has led them to attend summer school or, in the best of situations, to continue their education during the school year using distance learning. Because of the diversity of today's learners, it will be necessary to offer many forms of education such as distance education, evening and day classes, and online classes that cater to the needs of such a diverse population (OTA, 1993). Recognizing the importance of distance education in the expansion of educational opportunities, this study investigates the feasibility for professional development of an already-existent resource in many classrooms: The World Wide Web.

Purpose

The purpose of this study was to examine the use of the Web and electronic mail (email) as a viable option for the professional development of K-12 educators. Two classes were investigated, one delivered using the Web and another one in a face-to-face environment. The uniqueness of this study is that the two classes shared the same professor, syllabus, and textbooks, but differed by the medium of delivery. By keeping the former variables reasonably constant, it was possible to look into the interaction that the students might have had with the medium of delivery. This investigation also attempted to answer some of the theoretical questions pertaining to distance education. For instance, Harasim (1990) suggested that there is a critical need for research that informs and guides future applications of the distance education field to make this promise a viable reality. Levinson (1990) stated the need to investigate and research some qualities of electronic text, such as its revisability, interactivity, duplicability, transmissibility, storage, and promotion of cognitive skills. Levin, Kim, and Riel (1990) proposed more research in the commonalities and differences of electronic networks and face-to-face interaction in the following areas: (a) group organization, (b) task organization, (c) interaction, and (d) evaluation and coordination. The results presented in this proposal shed light on the use of Internet-based telecommunications to support both professional development and life-long learning in a constructivist environment, and attempted to answer some of the questions posed by previous research studies.

Theoretical Framework

Just-In-Time Consructivist Learning: The word "constructivist" is defined as both a theory of learning and a strategy for education which involves having students work on complex projects, often in groups, and synthesize information to construct their own understanding of a content area. In this framework, students learn technology skills and concepts in the context of using them to solve a real-world problem; for example, they might create a product they can use in their classroom. These projects follow from a theory of learning that suggests that subject matter becomes meaningful, and therefore understandable, when it is used in context-rich activities (Fosnot, 1996). The course was designed to emphasize the students' own responsibility for

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learning, for figuring out their own methods of solving problems, and for assessing their own work. Teachers who learn in this way will be better able to provide such environments for their own students.

Web-Based Instruction: Online teaching is a relatively new development, but recent research has shown it to have as much rigor and educational merit as is found in face-to-face courses (Sujo de Montes, 1999). Frank Odasz states, "The promise of online teaching is both the teacher and learner can be anywhere, participating at any time, through any type of microcomputer with modem. If online instruction can demonstrate economies of delivery of distance learning, it opens the door to ongoing learning for all potential learners" (Odasz, 1994). Christopher Dede (1996) says that technology can help transform schools—but only if it is used to support new models of teaching and learning. Interactive distance learning (distributed learning) is a use of technology which supports constuctivist pedagogy and school reform. It provides opportunities for faculty and students to communicate in and out of the classroom, become members of learning communities, utilize information from voice, text, and graphic sources, develop technology competencies, and construct and apply knowledge.

Methods and Data Sources

The main research question that guided this study was: Is the use of Internet-based telecommunications a viable option for university courses to address professional development practices for K-12 educators? In order to collect information and to understand how the participant (student) teachers constructed their knowledge and realities in both the online and the face-to-face classes, quantitative and qualitative methods were used. For the quantitative part, a pretest-posttest quasi-experimental design proposed to use the face-to-face class as a control group and the online class as an experimental unit. For the qualitative part of the study, three sources of data collection were used. The first data source was the Middle and End of the Semester Course Analysis, an email-delivered, open-ended questionnaire developed by Weber (1996). This questionnaire investigated the participant (student) teachers' class perceptions, and the perceived level of class satisfaction. The second data source consisted of in-depth interviews with a selected sample of participants from each class. These interviews were conducted using traditional face-to-face methods and online chat rooms. The third data source was the participant (student) teachers' electronic journals.

Conclusions

By keeping the instructional variables reasonably constant, it was possible to look into the interaction that the students might have had with the medium of delivery. The results of this study confirmed that the course taught over the Internet was at least as effective as the same course taught on campus. Distance learning was not found to be an education of inferior quality to those university courses taught on campus. However, successful face-to-face teachers do not necessarily make successful online instructors. Professional development at the university level is needed to provide distance learners with the quality that post secondary courses require and demand. Classes delivered on the Web provide a viable option for professional development, especially for those whose access to institutions of higher education is difficult or inconvenient. Additional research is necessary to compare and evaluate the viability of online synchronous interaction for indepth interviewing.

References

Cuban, L. (1998). High-tech schools and low-tech teaching. *Journal of computing in teacher education, 14*(2), 6-7.

Dede, C. (1996). The transformation of distance education to distributed learning. *Learning and Leading in Educational Technology*. April, 1996.

Fosnot, C.T. (1996). *Constructivism: Theory, perspectives, and practice.* New York: Teachers College Press, Columbia University.

Harasim, L. M. (1990). Online education: An environment for collaboration and intellectual amplification. In L. M. Harasim (Ed.), *Online education: Perspectives on a new environment* (pp. 39-64). New York: Praeger.

Levin, J. A., Kim, H., & Riel, M. M. (1990). Analyzing instructional interactions on electronic message networks. In L. M. Harasim (Ed.), *Online education: Perspectives on a new environment* (pp. 185-213). New York: Praeger.

Levinson, P. (1990). Computer conferencing in the context of the evolution of media. In L. M. Harasim (Ed.), *Online education: Perspectives on a new environment* (pp. 3-14). New York: Praeger.

Odasz, F. (1994). Online teaching: A significant new pedagogy, the community as a K-100 university. *Ed Journal*, January, 8(1), 1-4.

Office of Technology Assessment, U.S. Congress (1995). *Teachers and technology: Making the connection.* OTA-HER-616. Washington, DC: U.S. Government Printing Office.

Office of Technology Assessment, U.S. Congress (1993). *Adult Literacy and New Technologies: Tools for a Lifetime.* OTA-SET-550. Washington, DC: U.S. Government Printing Office.

Sujo de Montes, L. (1999). The use of Internet-based university courses as a tool for professional development of K-12 teachers. Unpublished doctoral dissertation, New Mexico State University.

Collaborative Learning in an Online Human Learning Course

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Abstract: This research focused on a graduate level human learning course taught both on the web and in a traditional face-to-face format. Course materials were presented to students on the web. All participation was via email using Listserv™ mailing lists. Twenty-eight students agreed to participate, twenty-two females and six males. The distribution of age and sex matched the graduate student population of the College of Education. A questionnaire developed from the Flashlight Student Inventory and individual student interviews were conducted for the purpose of evaluating learning outcomes. The majority of the students reported favorable learning outcomes. Course evaluations from both the online and the face-to-face sections of the course were compared and differences favoring the face-to-face format were found in the area of learning and overall enjoyment.

The period of uncritical enthusiasm for web-based instruction is past. Although there are many examples of excellent web-based courses, it is now clear that much more is involved than just presenting the components of a conventional course via the internet [Kahn 1997]. Lectures are not improved by translating them into HTML and discussions do not automatically happen when students are connected to a mailing list or computer bulletin board. One of the common themes in descriptions of successful web-based courses is the use of collaborative learning activities. The theoretical underpinnings come from instructional models based on learner-centered, constructivist, and socio-cultural ideas about learning [Bonk & King 1998].

This research focused on a graduate level human learning course taught both on the web and in a traditional face-to-face format by the second author. The first author had no formal connection with the course; her contacts with the students were strictly in the role of researcher. In its original format, the class met once a week for a ten-week quarter. A chapter of the text was discussed each week. Student learning was evaluated with an exam and a term paper.

The design of the online version of the course depended on the fact that the textbook for the course was excellent; little additional material from the instructor was necessary. In order to promote student learning in the online class, collaborative projects were established. The first assignment required each student to propose an educational project to design. Part of the second assignment asked each student to rank order the projects they were interested in. Then project groups of about five students were formed of students who were interested in the same project.

Course materials were presented to students on the web. All participation was via email using Listserv™ mailing lists. A typical week's assignment required students to apply a chapter in the textbook to the their project. Individual answers were sent to the mailing list for the project group and one person had the responsibility for reporting a summary to the mailing list for the whole class. The course was graded on a pass/fail basis. Participation in the group process was tracked and students who made minimal contributions to their group got reminders by email that more was expected of them.

The online version of this course is offered each spring quarter. This study is based on the third year of the course. The success of the online version led to a revision of the face-to-face course so that it now also uses collaborative project groups. Some course evaluation data from the revised face-to-face course is available for comparison.

Method

Thirty-six students registered for the class being studied. Twenty-eight students agreed to participate in the research, twenty-two females and six males. The distribution of age and sex matches the graduate student population of the College of Education.

There was a face-to-face organizational meeting prior to the beginning of the online course. At that meeting the research was explained and the informed consent form distributed. We were particularly careful to explain that the course instructor (second author) would not see and questionnaire or interview data associated with the student's name. At the end of the course, questionnaires were distributed to all participants and a sample of the students were interviewed. Additional data from the course evaluation questionnaire (require of all courses) were also utilized.

The primary questionnaire instrument was constructed from items in the Flashlight Current Student Inventory (Ehrmann and Zúñiga, 1997). This consists of a battery of nearly 500 items; only a small subset are to be used in any specific research study. The interview protocol used both items from the Flashlight Inventory and some specific questions about the human learning course.

Results

All students in the study are working on graduate degrees, either the masters degree (23) or the doctorate (5). The average quarter hours taken by the students was 13 hours. Twenty-five of the students reported being employed with an overall average workweek being 32.6 hours.

Questions taken from the Flashlight Student Inventory focused on student's attitudes and feelings toward learning online. Overall, student responses were favorable. The majority of the students were able to work on the course from either their home or office. Students reported spending less time traveling to and from campus, which made it easier to juggle school and work. Students reported spending on average 4.8 hours per week for the course. The majority of the students did not feel isolated from the instructor. Most students reported feeling that the instructor of the course was interested in what they had to say and that the instructor's comments were useful and helped facilitate learning. When students were asked if they felt isolated from other students or felt that they had missed comments made during a discussion they reported on average feeling about the same as if the course was taught in a traditional setting. Students felt about the same when it came to comfort in participating in a discussion or working in a group. When course evaluation data from the revised face-to-face section was compared to the online section, differences were found in amount of learning and overall enjoyment. Although both the online and face-to-face courses rated the collaborative learning style higher than a traditional lecture style course, the face-to-face evaluations were still significantly higher ($p. < .05$) than the online section in the amount of learning and enjoyment experienced.

Conclusions

The offering of web-based courses is of tremendous benefit to some students because it frees them from constraints of time and place of participation. We are confident that are analysis demonstrates that the engagement of the students with the course material is sufficient to treat the two forms of the course as educationally equivalent. In addition, the understanding we get of participation from the students' point of view is extremely helpful for instructors who wish to design more effective web-based instruction. There are some students for whom the use of technology creates a barrier. More ways of helping those students are needed.

References

Bonk, C.J & King, K.S. (1998). Electronic Collaborators. Mahwah, NJ: Erlbaum.

Ehrmann, S.C & Zuñiga, R.E (1997). The Flashlight Evaluation Handbook. Washington, DC: TLT Group.

Kahn, B.H. (1997). Web-Based Instruction. Englewood Cliffs, NJ: Educational Technology Publications.

Knowledge Transfer and Knowledge Discovery - New Improvements for the Corporate Decision

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Abstract: For a commercial company it is very important to be able to transfer relevant information to corporate knowledge. Therefore, a new concept must support and manage the information-to-knowledge and the knowledge-to-information cycle by using trustworthy knowledge repositories and personalised retrieval systems. The xFIND system represents an approach to a future-oriented knowledge system, which supports the corporate decision-making process combined with the interaction and collaboration between employees and users outside the company. It processes Intranet and Internet sources. xFIND offers features to handle the information life cycle and fits into the concept of a knowledge management environment.

1. Introduction

The implemented prototype of an intelligent search system xFIND (Extendable Framework for Information Discovery) is based on HIKS [Dietinger et al. 99]. A very important subject was found in the field of corporate knowledge management. Informed and well-trained employees are becoming more and more important for companies and their success on the global market. By providing users with information, advice and experiences relevant for the particular situation, helps to improve their problem solving. The decision-making process is substantial to the management at any level and every part of a company. Consequently relevant and qualitative information has to be provided. To reach this goal a new concept for information gathering, distribution and managing is needed.

In [Chislenko 97] value-added services for the knowledge process may include specialised knowledge repositories, retrieval systems and semantic search engines. Furthermore, reputation broker agent certification systems and recommendation systems should be taken into account. An automated subject classification system, a quality rating system and dynamic document maintenance should offer added values. Personal needs with respect to the current problem (task specific, position specific), previous experience and references to further domain knowledge (e.g. problem base, background library and communication with experts) have to be taken into account for every employee. Not only the active demand for information has to be supported but also a optional offer of additional information should automatically be given to the users too. Problem solutions and relevant, qualitative information from users must be archived and be problem-dependably provided to other users. *"Consequently, many business activities require access to a variety of information systems both within and across organisational boundaries."* [Huang et al., 99] In the knowledge gathering process internal and external information has to be taken into account. The internal information can be located at central corporate systems (e.g. Intranet system, knowledge bases). Relevant documents may also be saved on PC stations of employees. The Internet represents an important external information source. Because of the variety of document formats and information services, an open and extendable knowledge system is required. Such a system should integrate various systems or provide an API for co-operation during the management process. In [Huang et al., 99] an

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analogy to the classical marketing notation "product life cycle" is described. Here, the information life cycle *"can be divided into four stages: introduction (creation), growth, maturity and decline."* Bearing in mind this model, a future-oriented knowledge system should be able to manage pieces of information over the life cycle. An important feature of the retrieval process is to provide users with original information and additional information, and to consider additional information for the ranking process.

2. The Concept of xFIND (Extendable Framework for Information Discovery)

The xFIND system handles the information life cycle and fits into the concept of a knowledge management environment. Because of platform independence xFIND is implemented in Java. In order to achieve scalability xFIND is splitted into following three main parts: the Gatherer, the Indexer and the Knowledge Broker.

The **Gatherer** performs the task of visiting servers and gathering information from various sources as well as pre-processing the document data. It identifies a wide range of data like title, keywords, links, images and other embedded objects like Java applets. It also creates an electronic fingerprint of each information object. Fingerprint satisfies the need for trustworthy information in case of replication and allows detecting the origin of every piece of information. xFIND allows a wide range of configurations for pre-processing this data as well as handling meta data sets (Dublin Core [Weibel et al., 98], LOM [Hodgins et al., 98] and a special xFIND set) and their conversion to each other. Best performance and reduction of server and network load can be reached by using a local Gatherer. Local Gatherer can be configured to search for read-protected information. The Gatherer gets only a subset, original information remains protected. Furthermore, highly dynamical information can contact xFIND and external systems for information may be taken into account.

The pre-processed data can be fetched or sent compressed to one or more Indexers. Any **Indexer** may be specialised on a particular topic or can be dedicated to a work group or a department. Only authorised Indexers are allowed to operate with Gatherers. The Indexer's task is to allow the Knowledge Broker to assign words, phrases and meta data to documents, and to provide statistic data (e.g. term frequencies). It also contains descriptions of information sources (e.g. web areas) or documents, and it manages the communication with external systems (external information bases, ranting systems, ACF, archiving systems, etc.). The later, if trusted, are allowed to send additional information to the xFIND system or can inform the xFIND system about new or modified pieces of information. XFIND allows replication of one Indexer to arbitrary other ones. Fingerprints (public and private keys) for all pieces of information will guarantee original documents.

The starting point for user interactions is the **Knowledge Broker.** It is also considered as the main part of the whole system and designed for a distributed concept. Knowledge Brokers distribute their search queries to a particular set of Indexers corresponding to the current problem as described below. Furthermore, past search results and user ratings may be considered to improve future search queries and the quality of information. Knowledge Brokers can be specialised on a particular topic and are able to transform the employees' problems into proper search queries. Knowledge Brokers can be individually tailored for a division, a department, a group of employees or even for a single user. This includes a specialisation of Knowledge Brokers that satisfies the needs of a particular unit (e.g. a small research group or sales division). The system also provides a Personal Knowledge Broker. Quite similar to an agent system the Personal Knowledge Broker is adaptable to user habits and their current problems. Combining it with an ordinary web browser, additional information can be provided (quality ratings, annotations, similar documents, dynamic generated links, etc.).

3. Conclusions and Future Work

The introduced xFIND system is a step to the next generation of knowledge processing and opens a way from information society to knowledge society. The systems distributed architecture leads to scalability and efficiency. First experience shows interesting application in the business (e.g. decision-making process). In the field of WBT the system introduces new paradigms of combining static and dynamic information repositories. Further development of the system deals with the usage of software agent systems and automatic classification.

Literature:

[Chislenko 97] Chislenko A.: Semantic Web - a vision of the future of intelligent Web, June 1997 (1997), http://www.lucifer.com/~sasha/articles/SemanticWeb.html

[Dietinger et al., 98] Dietinger T., Gütl C., Maurer H., Pivec M., Schmaranz K.: Intelligent Knowledge Gathering and Managemant as New Ways of an Improved Learning Process, Proceeding of WebNet 98, World Conference of the WWW, Internet & Intranet, Orlando, Florida, Nov. 7 - 12, (1998), p. 244 - 249

[Dietinger et al. 99] Dietinger T., Gütl Ch., Knögler B., Neussl D. and Schmaranz K.: Dynamic Background Libraries - New Developments In Distance Education Using HIKS, J.UCS vol 5, no 1, (1999)

[Huang et al., 99] Huang K., Lee Y. W., Wang R. Y.: Quality Information and Knowledge, 1999 Prentice Hall PTR, New Jersey, USA, (1999)

[Hodgins et al., 98] Hodgins W., Wason T., Duval E.: Learning Object Metadata (LOM), Draft Document v2.1, 25 June 1998, IEEE Learning Technology Standards Committee (LTSC), (1998),

[Weibel et al., 98] Weibel S., Kunze J., Lagoze C., Wolf M.: Dublin Core Metadata for Resource Discovery, The Internet Society, September 98, (1998), ftp://ftp.isi.edu/in-notes/rfc2413.txt

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TEAM 21: A Framework for the Total Enterprise

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Abstract: TEAM 21 explores a methodology for enabling computer and business experts to work together to create systems that automate the information needs of the enterprise in a framework that is faithful to the business model of the enterprise. Development is focused on rapid prototyping to quickly enable a cross-fertilization of ideas between the business and technical experts involved in development. The approach emphasizes simplicity in the sense that final systems provide the functionality that is needed, and no more. The emphasis is also on use of a transaction-based, federated architecture that results in modular systems that are scalable, modifiable, and reusable.

1. Overview

The current focus of much work in the e-commerce area is on putting in place on-line stores to sell products to customers. The appeal of that approach is that anyone, anywhere, with a Web browser can access the store and make purchases. The same benefit can be realized to institute more complete enterprise information solutions that facilitate employee transactions within the enterprise, business-to-business transactions, and division-to-division transactions. On-line approaches provide a direct means for establishing paperless business transactions. This approach leads to new ideas for restructuring business transactions so that transactions can be processed more quickly and accurately.

In order to realize the full benefits of an Internet-based approach it is necessary to go beyond simple order taking Web applications and look at a full range of transactions involving sophisticated business modeling and database needs. Technical expertise is needed to make use of the computer related capabilities available over the Internet, and at the same time business expertise is needed to faithfully model the enterprise.

2. Problems

The principal problem in using the Internet as a vehicle for complex business transactions is that the Internet protocols were not designed to support such transactions. The Web environment was designed to provide access to on-line documents. In order to support a rich commercial environment it is necessary to overcome some critical shortcomings related to the stateless environment of the Web, the lack of direct support for high level constructs, and the need for security.

A variety of new possibilities are being developed for overcoming the shortcomings of the Web environment. All of the new approaches bring some benefits, but it remains true that the goal of completely automating an enterprise's information needs is often exceedingly complex and expensive. It is not unusual to see potential enterprise solutions offered for prices beginning at $250,000 and for installation periods beginning at six months. Moreover, problems still exist in installing actual systems both because installation experts often do not understand the real needs of the enterprise, and because the business experts do not understand the real capabilities of the available technologies.

3. Simplifying the Process

We have been exploring a methodology aimed at reducing the overall complexity involved in building and deploying enterprise level solutions for Internet-based business transactions. There are three basic thrusts of the methodology. First, there is a separation between the inputs from the business domain experts and the technical experts. This separation means that business experts can control the business aspects of the system without interfering in technical decisions, and vice versa. Second, there is an insistence on only providing the functionality needed to perform specific business tasks rather than trying to provide all functionality that might be required for any business tasks. Third, there is an emphasis on making use of existing tools and applications rather than on replacing or replicating what already exists in the enterprise.

3.1. Separation of Business from Technical Aspects

In order to keep the business and technical inputs separate, we use an architecture in which the business experts are provided with a separate administrative tool that lets them specify the business processes. The business processes are specified through an interface that lets the user directly lay out the relationship between the activities that are supported by the system and the roles that users of the system can have. User roles are defined in terms of the set of activities associated with a particular role. Activities are defined in terms of business transactions such as entering or approving orders, generating reports, or responding to requests for data.

As the business experts work on refining the business processes, the technical experts can use that model to learn what capabilities the system needs to support. They are also then in a position to suggest and demonstrate technological possibilities the business experts may not be aware of.

3.2. Limited Functionality

TEAM 21 emphasizes a transaction based approach. Each transaction can be used in a system independently of other transactions. That modularity means that systems can be put in service incrementally as each transaction is built.

The TEAM 21 approach begins by defining the business process with a view to identifying the precise functionality that is needed. Systems are then developed to provide only that needed functionality. These systems are developed through rapid prototyping so that end users of the system can make actual use of the system as it is developed, and they can provide constant feedback as to whether their needs are met.

3.3. Use of Existing Tools

Two problems arise when existing tools are replaced. One problem is that costs go up, especially when a substantial work is required to replace such tools. The second problem is that users are often required to expend substantial amounts of time learning to use the re-implemented system, when they already understood the existing system and were fully satisfied with it. The TEAM 21 methodology stresses the continued use of existing tools.

Because TEAM 21 focuses on a methodology instead of on a comprehensive new product, resulting systems can make use of whatever products are currently available to solve particular problems. The flexibility presented by this methodology means that the best available approaches can be used to solve particular needs. This flexibility is often missing in other approaches where a particular set of tools must be used as an integral part of a new application.

TEAM 21 is able to fuse a wide variety of existing tools and technologies into a loosely integrated whole because it relies on a federated architecture. The architecture is designed to loosely tie a variety of pieces together such that pieces can be used independently from the overall system, and such that each piece can be changed with little or no impact on the overall system.

4. Conclusion

The work on TEAM 21 has focused on providing a methodology that addresses some of the problems inherent in developing Internet-based solutions for automating enterprise-wide business processes. The approach we are exploring promises to provide a flexible means for providing enterprise level solutions at less cost than other current approaches. Gains are realized in part by providing a separate interface for specifying the business processes, so that business domain experts can input their expertise without needing to know about the technical details. That separation also allows the technical experts to easily make use of the business expertise. The focus in TEAM 21 is put on understanding and supporting existing business processes, rather than on building new functionality.

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Demands on virtual teams and virtual leadership to support sustainable learning processes

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Abstract: The objective of this paper is to discuss new organisations directed towards projects and teamwork, as well as how many of these functions can be enhanced, supported and, of course made better through the utilisation of Computer Supported Collaborative Work (CSCW). Thus making work and leadership less dependent on physical presence, i.e. time and space. This also increases the possibilities of global virtual teamwork, i e cross cultural work and management, in widespread organisations. This objective is met through research of the following functions: support of personnel, administrative tasks, taking part in the work process and strategic planing.

The outcome of the research project is ideas how the virtual team role is developed in organizing the work, how the team goes about daily routines, daily work, supports of personnel, administrative work, creation of a learning environment, as well as thinking and working strategically. This is created through the CSCW.

Background

The virtual team in its extended meaning is a rare occurrence, it is a social construction(Berger & Luckman, 1967), stemming of the possibilities with IT. In this article is however a small company presented that is coming close to what can be called the virtual team. Some work related to the proposed topic has been done within the research field of Computer Supported Collaborative Work (CSCW) (Ellis et al, 1991. The question this poses is: What are the demands on the virtual team and leader to support a sustainable learning process.
The paper is primarily argumentative, of course based on rigorous studies of teams and their relation to IT.
The phenomenon competency is referred to as the ability to work together as a collective towards a task. Collective competency is conclusively the phenomenon of a group or organization of people's ability to work towards a common task in a sufficient way (Hansson, 1998). The interpersonal competence involves the relationship amongst the people in the team and the practical competence is directed towards the task of the team (Hansson, 1998). Roletaking is (Mead, 1969) in a sense the primary process of the team where the socialisation of the individual into the group. Sensemaking (Weick, 1995) is the process, which follows roletaking, and the meaning created in the sensemaking process is the basis for the action the group performs. In the different constellations we can see where the different groups were in the process of creating the joint meaning for action. Here, gestures, symbols and language are viewed as a carrier of roletaking and sensemaking (Mead, 1969), as it is through these media they are transferred.
The relation between time and space has come to be one of the more interesting aspects in that the action can always be referred to as having a place in the time-space matrix (Bergson, 1912; Mead, 1938). However, it can also be discussed in terms of temporal appearance as a process of emergence, sustaining, and diminishing (Hansson, 1998).
The methodology for studying the virtual company or virtual team elaborated in this article represents a variety of different methods, interpretative-interactionist best decribe this.

The real business through virtual teamwork

The description of a small Swedish consultancy firm, is somewhat schematic although based on thorough studies of action research during a period of one and a half year. The presentation aims at giving a reference to the further discussion rather than aiming to be evidential in a stricter sense. The firm has a personnel force of five people in the core, and 3 more peripheral. What makes the firm virtual is primarily the fact that it does not have an office, one reason for calling it a virtual company. The common area for interaction is an extensive, well utilized and official workspace where all activities are discussed, referred, developed and filed. Physical meetings do occur every other week where practical matters as well as strategic or policy discussions are brought up.

The intranet of this company is quite elaborate. The core of the intranet is a forum for discussion. Here the daily matters are discussed, posed etc. There is also a "customer space" where the more formal contacts with customers are presented. There is also an agenda of action, contacts to be made, thing to do, etc. As a basis for this work there is a structure called "webfolders" which is a database interface in the form of a file structure very similar to the personal computers own interface for file handling. The difference is that this webfolder is virtual in the sense it is connected to a server database. In spite of this it is as simple to use as the personal computer with features such as drag and drop, file hierarchies, accessible and restructurable for all.

Leadership and organizing the team

Recent studies of teamwork (Hansson, 1998) enhances the notion that amongst other things the leaders role is fundamentally different than a traditional functional leader, this becomes very obvious in the virtual team (Lipnack and Stamps, 1997). In fact the two roles of the leader represents two entirely different perspective, traditional leadership and empowering leadership. The empowering leader has come more into focus in recent organizational setting, especially when teamwork is emphasized. This type of leadership has increased the possibilities for enacting leadership in new ways, incorporating IT as a management tool to create sustainable learning processes within the organization.

The foremost principle for the virtual team is organizing. The discussion is not new, however, it was initialised by Weick as early as in 1969 (Weick, 1976). The reasoning here is grounded on the somewhat different process perspective of Bergson and Whitehead, Schutz and Mead are also involved in the discussion of organising principles of meaning and socialisation.

The thought of looking at the world from a temporal perspective is brought up i e from the perspective of assyncronous or syncronous events on the IT based learning process. Time as an organizing principle includes the practical competence being developed over time as well as the interpersonal revealing itself at a certain point in time.

A paradox has been observed in organizing groups with a proficient practical skill since they often emphasise their own development over the group's. The concluding remark of the above themes are concluded with leadership being important in organising teamwork, and can subsequently be summarised in a similar way where the leader needs to be able to be forceful on occasion, whereas in the daily process his task is to maintain the flow through support and encouragement of the process.

Berger, P. L., & Luckman, T. (1967). The Social Construction of Reality. Garden City, N.Y.: Doubleday.

Bergson, H. (1912). *Tiden och den fria viljan*. Stockholm: Wahlström & Widstrand.

Ellis, C. A., Gibbs, S. J. & Rein, G. L. (1991) Groupware: Some issues and experiences. Communication of the ACM 34 (1), 38-58

Hansson, H. (1998). Kollektiv kompetens - en studie av skicklig interaktiv handling. Göteborg: BAS.

Lipnack , J and Stamps, J. Virtual Teams (New York, John Wiley & Sons, 1997)

Mead, G. H. (1938). The Philosophy of the Act. Chicago: University of Chicago Press.

Mead, G. H. (1969). Mind, Self and Society. Chicago:

Schutz, A och Luckmann, T. *The Structures of the Life-World* (Evanston: Northwestern University Press, 1973).

Weick, K, *The Social Psychology of Organizing* (Reading, Mass: Addison-Wesley, 1979a).

Weick, K E, *Sensemaking in Organizations* (Thousand Oaks: SAGE, 1995).

Whitehead, A N, *Alfred North Whitehead – an anthology* (New York: Macmillan, 1961).

Design, Implementation and Operation of an Intranet-based University-Information-Management-System

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Abstract: Most of the running university-information-management-systems are suffering from the lack of an up-to-date and well-designed data-model that includes all types of resources (personel, inventory, rooms, lectures, research-activities,...) and their relations between them. We have tried to set up such a data-model from scratch. As user-interface to that model we have designed an intranet-based application, that includes personal identification, the granting of functions to persons and the appointment of functions to specific program-modules that operate on different resources. This application-system can be operated without central management.

Outsourcing or not

We did an evaluation on outsourcing the whole systems design and implementation and came to the result that the costs for outsourcing are immense high. There are a only a few companies in Europe that offer commercial university-information-management-systems. There are still many constraints typical for austrian universities that cannot be parameterized in the systems and therefore have to be programmed additionally which makes the systems even more expensive. At the end we decided that the design and the implementation should be done inhouse.

The Entity-Relationship(E/R)-Model

The design of the E/R-model started from scratch. The whole E/R-model consists mainly of six sub-E/R-models with base-entities representing the base-resources, and the relations between them (see figure). The knowledge on the E/R-model gives the opportunity to act and react very flexible to requirements from the university by changing or adding entities, relations and their proper applications.

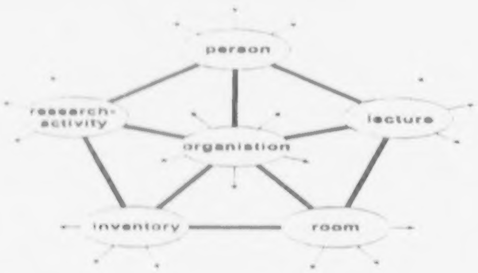

Figure 1: Entity/Relationship-model

The Application-Model

The application-model is designed in a very generic way, so it can be adapted to every universities needs. It consists of five embedded layers:

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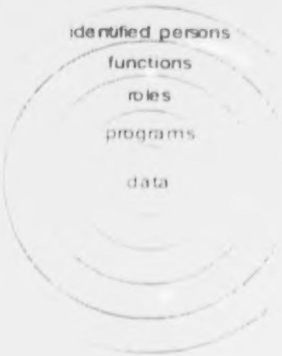

Figure 2: application-model

The whole model with ist layers is integrated in the Entity-Relationship-model, with each layer as an entity and relations between adjacent layers. Below you get a description of the layers:

data: are entities and their relations representing the different resources.

programs: are applications that have access to the data.

roles: define privileges for programs. Each program is connected to one ore more roles.

functions: define the way for an identified person to access data: identified person -> function -> role -> program -> data. A function is always connected to an organisation, that means a person gets a function only in relation to an organisation. The function called *Function-/PINcode-manager*: With this function a person gets the privilege to attach departments functions to persons, so he/she becomes the function-manager of the department.

identified persons: are real persons known to the system by unique usernames/passwords.

The proper organisation decides whether a person that belongs to that organisations gets an entry to the system or not. The Function-/PINcode-manager can grant a PIN-code to a person by Email. This Code allows the person itself to choose a unique username/password.

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WWW Hyperbooks Created for Teaching Electric Power Engineering

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Abstract. This paper introduces a few WWW Hyperbooks for Teaching Electric Power Engineering produced at Tampere University of Technology. These books are the Electrical Network Book, Harmonic Book, Transformer Book and Electric Power Engineering Book. All books were programmed in HTML. The WWW hyperbooks have been used in the teaching of different courses at Electric Power Engineering.

1. Introduction

The development of WWW and multimedia based tools for teaching electric power engineering started in the 80's at Electric Power Engineering. At the beginning of the study a few multimedia and hypermedia applications were developed for teaching and learning electric power engineering.

Hypermedia programs, HyperLecture, Harmonics and TraLab96, have been developed with Asymetrix ToolBook for teaching electric power engineering. HyperLecture was designed for lecture teaching on electrical machines and transformers. HyperLecture contains four different parts: transformers, synchronous machines, asynchronous machines and direct-current machines.

The TraLab96 hypermedia program was developed after HyperLecture for teaching and learning about transformers. The program is divided into three modules: the theory module, the experiment module and the design module. The purpose of the theory module is to introduce the present curriculum on single-phase transformers by means of hypermedia. Experimental calculations can be made on interactive pages of the experimental module. The design process of the distribution transformer was also made into the form of hyperbook in the program.

Nowadays, the effect of the Internet on all information and communication increases continuously. This has meant that, more or less, the focus has moved towards Internet and WWW applications. Therefore the focus has moved to making WWW programs. For example, interactive calculation exercises are available at WWW server of Electric Power Engineering. The aim of this paper is to present new Internet based WWW hyperbooks for supporting teaching of electric power engineering at TUT.

2. WWW Hyperbooks

Electric Power Engineering has at the moment four WWW programs available at the WWW-servers of TUT. They are (in chronological order): Electrical Network Book (http://www.tut.fi/~korpinen/ALKU.HTM) (in Finnish), Harmonics Book (http://svt.ee.tut.fi/harmo/eng/harmoeng.htm) (in English and Finnish), Transformer Book (http://svt.ee.tut.fi/transformer/) (in English) and Electric Power Engineering Book (http://svt.ee.tut.fi/svtopus/pruju.html) (in Finnish). All the WWW hyperbooks have a somewhat different structure.

The Electrical Network Book (in Finnish) was designed for supporting the course, which handles power systems. The course belongs to the subject studies of Electric Power Engineering. The course contains, e.g., calculation of transmission and distribution networks, short circuit and earth fault issues. The Electrical Network Book includes four main parts: electric networks, voltage drop, losses, and faults. The faults include calculation of three-phase short circuit and earth fault. Information structure in this book is not very suitable for self-studying. The book has been created in HTML containing 60 files.

The Harmonics Book was created based on the previous study about power system harmonics. The Harmonics Book was designed in HTML for students of electric power engineering who have a basic knowledge of electric power systems. The Harmonics Book supports the Industrial Power Systems course, which belongs to subject studies of Electric Power Engineering. The program helps to become familiar with the phenomena related to harmonics and presents methods on how to get rid of harmful harmonics.

The Transformer Book (in English) was created based on theory sections of TraLab96 hypermedia program. The Transformer Book supports the Switching and Control Devices, and Power Engineering Project Work courses, which belong to subject studies of Electric Power Engineering. The Transformer Book contains the basics of electromagnetics, distribution transformers and current transformers.

The most recent WWW hyperbook in the series, Electric Power Engineering Book, (in Finnish) contains the basics of electric power engineering. This WWW hyperbook was created based on a textbook written for the "Introduction to Power Engineering" course. All students of the department of Electric Engineering (about 200) take this course in their second year. The course includes lectures, exercises and laboratory works. Students can also use the WWW hyperbook later to revise their information when they need it.

3. Discussion

Four WWW based hyperbooks for teaching on electric power engineering have been developed at the Electric Power Engineering at Tampere University of Technology (TUT). They are Internet based applications and they were programmed in HTML. This makes them easy to access for the students. At Electric Power Engineering, TUT, the WWW hyperbooks have been used in the teaching of different courses. The experiences from new computer based teaching tools have been mainly positive.

Presently, the WWW hyperbooks are mainly hypertext books, but they can be further developed to be more interactive. For example, some kind of exercises can be used for expanding WWW hyperbooks to be more interactive. Appropriate exercises could be added in suitable places in the WWW hyperbooks.

The new teaching tools have possibly offered a variety for students and also given additional information besides traditional lecture teaching in the classroom. The WWW hyperbooks are also suitable for self-study purposes.

In addition to being used for teaching at TUT, the hyperbooks can be used in other places as well. The hyperbooks are freely accessible on the Internet. In this way they can be used for example after graduation to revise necessary information. The Internet is also a good channel for extension and continuing education.

In conclusion it can be said that based on experiences and feedback the developed teaching tools have been useful, and they are worth further developing in the future. Continuous improvement of WWW tools also promotes further development of the WWW hyperbooks.

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Bleeding on the Edge II:
Instructing with Live Audio, Video, and Text over the Internet

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Abstract: A recent master's level delivered live audio, video and text over the Internet. This course combined two sections: one located in front of the instructor, and the other with students in several remote cities. All classes were video encoded over the Internet using RealVideo software. Remote students would point their web browser to the class site, viewing textual and graphic content in the browser while simultaneously listening to and watching the instructor using RealPlayer. Remote student questions were communicated with the instructor over a web-based chat room, and students in both sections interacted in an out of class, on-line discussion board. All classes were also videotaped, then digitized on the server for later viewing by all students. Difficulties were minor and both local and remote students reported being pleased with this method of instruction, although instructors need to be aware of the benefits and drawbacks.

Background

The Department of Educational Administration and Foundations, a graduate-level unit of the College of Education at Illinois State University, has as one of its primary missions the preparation of educational leaders in public schools. Accomplishing this mission often requires teaching courses off campus. One particular off-campus cohort draws students from a wide geographic area located loosely around the Quad Cities, approximately two and one-half hours from campus. That distance made weekly travel impractical. Intensive, multi-day weekend sessions were examined as an alternative, although certain courses do not adapt well to this delivery format. Dedicated-line compressed video is a popular options except that these off-campus students – all working professionals – were hard pressed to all have a common day or evening to meet, together with each being physically located up to two hours from the others. Asynchronous Internet-based (web) instruction has also been used in other subject areas, although there was some concern about teaching a master's level, qualitative research class (with all of the introspection and discussion that goes with such a course) solely asynchronously. Compressed two-way audio and video over the Internet using CU-SeeMe had been used in a prior semester (a paper was presented on this experimental effort at WebNet 98 titled "Bleeding on the Edge: Experiences from Teaching a Multimedia-Rich Course over the Internet" by Hecht and Schoon). Unfortunately, this method proved less than completely reliable, and required a substantial investment in hardware and software resources, and instructor and student time learning complicated software, to fully realize. *Could another Internet-based audio and video solution be found that would work better and easier?*

An investigation was begun in the Spring of 1998 to search for alternative solutions, and several different products were experimented with. By mid-summer of 1998 one approach had been chosen, and the necessary software (RealVideo and RealServer version 5) was purchased and installed at the University. The server software was loaded on a Dell Pentium-II computer having a 450Mhz processor, 192 Mb of memory, a standard monitor with 4Mb of video RAM, and two high-speed token ring connections running Windows NT version 4 (SP-3). One of the token ring cards was dedicated to providing the web (http://) services, while the other card was tasked with serving video (pnm://) services. A second computer (another Dell running Windows 95) was equipped with an Osprey 100 video capture card. This machine served as the audio-video capture station, taking the feeds from the instructional classroom, encoding them as Real streams, and transmitting these streams to the server for distribution to the students. In addition, a Panasonic AG-5700 video deck was used to capture the audio and video to tape, where it was digitally encoded the next day and made available for asynchronous viewing by the students.

The first task facing the instructor was the setup, installation, and testing of the various hardware and software components. Different transmit band widths, audio and video codecs, and connection strategies were experimented with over the course of almost two months of trials. During the same time the instructor was reformatting courseware for this new model of delivery. To facilitate the evaluation of this course the instructor kept a daily diary, recording his observations and experiences. Students were encouraged to e-mail the instructor detailing their impressions, as were the technical staff assisting with the project and the graduate teaching assistant. These written records, together with records from the live chat sessions and class discussion board, were examined as the record of the course activities.

Results

The class began in mid-August of 1998 with the instructor visiting the remote students at a high-tech classroom located at a

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college in the Quad Cities. During this session students were introduced to the technology of RealVideo, along with reviewing the basics of computer operations, web browser usage, and sending and receiving e-mail over the Internet. Almost all of the students were using Windows 95 systems, with only two using Macs. Student vacillated between Netscape's Navigator (version 4.xx) or Microsoft's Internet Explorer (version 4.xx) as their choice of browsers. Most utilized Eudora as their e-mail program of choice, and RealPlayer (version 5) was required to view the class sessions. These remote students also received their first hour hours of content instruction in the qualitative research course.

One week later the actual semester started. On-campus students attended each session in a high-tech, distance education classroom, fully equipped with the latest in video, graphic, computer, and projection technologies. While this room was normally used for dedicated line, compressed video instruction, it turned out to be the perfect platform for this class as well, generating a clean video signal and distortion free audio for transmission over the Internet. This facility allowed the instructor to seamlessly switch between several different camera views of either himself or the local class, to display computer generated graphics or web pages, or to use a variety of different media devices (including: a document camera, video tape player, and white board). The room also had facilities for utilizing a laptop computer, and for integrating additional A/V inputs of varying types, something the instructor made frequent use of during the semester.

Remote students had the option to participate in the class live (synchronously), or to engage in the material (asynchronously) and watch the taped class session later whenever they wanted. Work commitments and local technical difficulties only allowed approximately half of the remote students to participate in each class live. Those students would typically have three applications running on their computers at one time: a browser window pointing to the class web site containing the textual and graphic content for that class; a second browser window open to the real-time chat room; and the Real Player program receiving the live audio and video feed. These students could then interact with the instructor and campus students by typing comments or questions into the real-time chat window. Audio/video buffering and student typing speed typically resulted in between a 20 to 50 second delay from the time a remote student would hear something on the Real Player and when the instructor would receive back a comment or question on the chat.

Surprisingly, all of the classes were held without any technical difficulties! The encoding and server software performed exactly as advertised, operating for 15 full three hour class without any crashes or interruptions. Remote students occasionally reported the Real Player "locking", a condition that was easily solved by restarting the player application. Likewise, the chat software worked quite well. A graduate teaching assistance in the campus classroom handled typed communication with the remote students, verbally passing their comments and questions on to the instructor. This method proved quite effective, as the G.T.A. often was able to respond to non-content questions (e.g., technical, assignment, etc.) by typing a response back into the chat without interrupting the instructor or the flow of the class. All of the distant students, and many of the local students, reported watching one or more of the taped classes on-line after the fact, either because they were unable to participate in the live session, or (more interestingly), because they wanted to brush up on something that wasn't fully understood during the live class. This taped class feature proved to be the most popular of all the technology options to both sections of students!

Conclusions

Real Video was a relatively easy, straightforward system to set up and operate. The various components (live encoder, server, and player) all performed exactly as their specifications described. This allowed off-campus students to watch and hear a live classroom feed and to participate, though a typewritten chat window, in real time with that class. Very little computer expertise was necessary on the part of the student, although the instructor did invest a significant amount of time and energy redesigning his course for this new method of delivery. The off-campus students enjoyed not having to come to campus for their instruction, yet being able to participate in the classes from wherever they were located. The on-campus students were able to interact with their off-campus counterparts through the chat dialogue, and appreciated the on-line video tapes of class sessions for asynchronous use. While some specialized hardware (e.g., a video capture card) is necessary to conduct a class in this way, it is not nearly as expensive nor technically difficult as other means of distance education. Overall, this class demonstrated the ease with which synchronous audio and video could be delivered over the Internet. Although not appropriate for all kinds of instruction, this method is a viable means for those wishing to expand their distance education capabilities in an easy, relatively low cost way.

Web Pedagogy: Extended Seminars on the World Wide Web

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Abstract: The new opportunities offered by computer networks require new kind of pedagogical thinking and course organization. The way to do it - web pedagogy - is still in its infancy, but what is already evident, is that learning on the World Wide Web calls for fearless re-evaluation of the current pedagogical practices. In this paper we introduce a course format where the World Wide Web turned out to be crucial for the success of the course. The new technology via a computer conferencing and groupware system brought together two groups of students from two locations geographically separated by 100 kilometers. The course organization pedagogically emphasized the synergetic features of the face-to-face and Web learning.

Web pedagogy is much more than teachers just knowing how to set up and use, for example, an IRC, FTP, or a conferencing software service. Moreover, using these technologies on the margins of serious instruction is seldom enough. Unfortunately, the Web is often only an "add-on". For example, [Althauser & Matuga 1998] report that "creating a computer conference but not requiring students to participate characterizes roughly 50% of the conferences established each year at Indiana University". Indeed, Web pedagogy comprises besides careful and conscious selection of appropriate Web tools also a lot of "know-how" in orchestrating their use in order to foster student learning. The new situation seems to call for fearless re-evaluation of the current pedagogical practices. Recently innovative ways emphasizing creative, critical and collaborative activities for the learners have been suggested [Bonk & Reynolds 1997]. However, not all that is old have to be useless in the new Internet world. Instead, "pedagogical re-engineering" of old courses is needed, e.g., in the ways outlined by [Collis 1996].

In this paper we introduce one way of "re-engineering" and extending university level seminar type courses. Face-to-face seminar discussions in computer science tend not to be very lively, and it is hard to continue them afterwards. We wanted to extend the traditional seminar sessions with special "pre-seminar" Web discussions. What made this specific course called "Internet-based learning environments" in autumn 1997 especially interesting was the fact the course at our faculty was linked to the same course given concurrently at the Teacher Education Faculty at a neighbouring town (in-service teachers extending their information technology studies). Now an idea arose to team up one in-service teacher with one student majoring in computer science. The problem here was how to get them to select their topics and facilitate them to do together the Web part and the face-to-face seminar presentation part? Our conferencing system came here to rescue [see Hietala et al. 1997].

Same number of students from these two locations was admitted to this course, altogether 36 students. The conferencing system allowed them to select the seminar topics they were interested at first-come-first-served basis. The "matching" of one in-service teacher and one computer science student was entirely carried out on the Web - we hoped that similar interests brought them together. Besides being active as a moderator (and a seminar presenter) in one topic the students were also required to select two topics to act as a designated commentator in these topics. After obtaining a partner to their work they made contact, mostly by e-mail but sometimes also by telephone, and started the work. The first thing to do was to prepare and publish their initial thoughts on their subject - in other words, to start to moderate a discussion thread within our conferencing system.

The students received guidelines how to act as a moderator: they were advised to carry out a free and open-minded discussion on their topic. The face-to-face seminar presentation, on the other hand, was required to be a more focussed. Its main purpose was to illustrate the main ideas of the topic by demonstrating one or two Web-based learning environments. The participants were encouraged to make use of the Web pre-discussions in their seminar presentations. The discussion period on the Web took five weeks and after that the face-to-face seminar sessions commenced. The in-service teachers were required to come to the computer science premises from the neighbouring town in order to give their presentation together with their partner. Many students reported this was the first time they actually saw their partner. Moreover, one session, comprising two seminar presentations, was carried out using video-conferencing facilities, the pairs presenting being 100 kilometers away from each other. These two pairs never met in real life!

In our opinion, the approach described above proved to be worth more experimenting. Credit must be given to the conferencing system. Our WWW-based discussion system that could be used anywhere through common Web browsers proved to be an easy-to-use and readily available tool also for those who used it for the first time. In addition, our system provided procedural facilitation for the discussions [see Hietala 1998]. Our course organization efforts were well received, too. The pre-discussion seemed to aptly support the actual seminar presentations, which turned out to be of good quality. As has been suggested from the theoretical point of view, the role of the lecturer changed from being the knowledge source and final solution provider to be more like a coach. The course organisation placed the students into peer teaching situations, and our students did take the responsibility. Students even wanted the discussions to be alive for a longer period than was planned, till the end of the course.

One difficult issue in the Web discussions is how to motivate the students. If discussions are not structured and no minimal participation is required, students tend to find something more important to do. Also during our course a few students "dozed off" and the lecturer had to send them private e-mail to get them back to commenting. Another problematic issue is how to grade the students. It was made clear from the beginning that both the content quality and the amount of student comments were essential for the grade. Nevertheless, one student expressed her dismay towards the activity measures (the number of comments in the Web discussions and in the seminar sessions was counted). Only the quality should be measured, both on the Web and in the classroom, she said. Indeed, we feel that the grading policy must be geared towards the quality of the comments instead of the amount of comments made. However, it is very cumbersome for the teacher to follow all the discussions close enough. Although our conferencing software provides already several monitoring tools for the teacher, we think this will be one of the major development directions in the near future.

References

Althauser, R. & Matuga, J.M. (1998). On the pedagogy of electronic instruction. In Bonk, C.J., King, K.S., (eds.), *Electronic collaborators: learner-centered technologies for literacy, apprenticeship, and discourse.* Mahwah, NJ: Lawrence Erlbaum. 183-108.

Bonk, C.J. & Reynolds, T.H. (1997). Learner-centered web instruction for higher-order thinking, teamwork, and apprenticeship. In Khan, B.H. (ed.), *Web-based instruction.* Englewood Cliffs, NJ: Educational Technology Publications. 167-178.

Collis, B. (1996). *Tele-learning in a digital world: the future of distance learning.* London: Thomson Press.

Hietala, P. (1998). Procedural facilitation in Web discussions. *IFIP Teleteaching'98: Distance learning, training and education.* Vienna: IFIP/Austrian Computer Society. 445-454.

Hietala, P., Niemirepo, T. & Ovaska, S. (1997). Using the World Wide Web to promote educational discussion on university level courses. In Verdejo, F., Davies, G. (eds.), *The Virtual Campus: Trends for Higher Education and Training.* London: Chapman & Hall. 169-183.

Context-Sensitive Filtering for Browsing on Web Pages

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Abstract: We have proposed a method to model user's shifting interest from browsing history. We call the filtering method Context-Sensitive Filtering, CSF for short. This paper describes an application of CSF to Web, that is, Web FALCON that divides a Web page into several parts with HTML tags and applies CSF to the parts. We also report experimental evaluation of Web FALCON.

1. Introduction

Information filtering is an important function whose request is high to Web users. Web provides a lot of information and a user can use it easily. However, he/she often gathers too much information to deal with all of them by him/herself. Information filtering is a function to reduce information that a user has to deal with directly.

To select information that a user has interest in, modeling of user's interest is indispensable function. Several modeling methods of user's interest have been proposed, but most of them have assumed that user's interest stable. However, browsing or surfing, which are most popular ways to gather information on Web, do not satisfy the assumption. During browsing, user's interest often shifts depending on local context of the browsing.

We have proposed a method to model user's shifting interest from browsing history. We call the filtering method Context-Sensitive Filtering, CSF for short. A filtering facility using CSF has been implemented for CD-ROM encyclopedia, and effectiveness of the facility has been confirmed by an experimental evaluation by real users [Hirashima 98].

This paper describes an application of CSF to Web. The most important issue to apply CSF to Web is modification of Web pages. Each Page in the encyclopedia has one topic and adequate volume to read through it briefly. The two characteristics are required by basic guideline to design well-formed hypertext. Effectiveness of CSF depends on these characteristics of the pages. In Web, however, one page often has several topics, or too much volume. Therefore, to modify Web pages is necessary to apply CSF to Web.

In this paper, We introduce Web FALCON that divides a Web page into several parts with HTML tags and applies CSF to the parts. We also report experimental evaluation of Web FALCON.

2. WebFALCON

2.1 Issues to apply CSF to Web pages

In user modeling of CSF, it is assumed that when a user visits a node and accepts the node, the user is interested in the content of the node. CSF is effective for CD-ROM encyclopedia because the assumption is suitable for the pages. When one node has several topics or too much volume to read it, a user often read a part of the page and does not read the rest of it. The part that the user does not read is noise for user modeling. To use CSF to WWW pages, modification of them is necessary.

In this section, we propose a division method of the pages by using HTML specification. Every Web page is written by HTML that is a subset of SGML. These are specifications to give a structure to a document. In other words, a Web page has a structure following HTML specification. Division with HTML tags is promising method to reduce noise for user modeling though it is not perfect.

2.2 Modification by HTML tags

By using HTML specification, the content of a page can be divided into several document blocks. Each Heading divides a part into several smaller parts. The lowest Heading makes the leaf document block that is semantic unity. This leaf document block is a divided page that is dealt with a page in CSF. Indexes of the divided page should be generated not only by the content, but also by the upper structure in the tree.

2.3 Interface

Interface of WebFALCON consists of four windows: Search Window, Selection Window, Page Window and User Modeling Window. First, a user can set an index as a keyword for retrieval in Search Window. A list of pages including the index is shown in Selection Window. CSF performs for the ordering of the pages. By clicking a page in Selection Window, the content of the page is shown in Page Window. Here, when the page is a part of a Web page, the whole page is provided to the Page Window and the part is shown at the head of the window. User Modeling Window is used to acquire parts that a user reads and accepts. Current version of WebFALCON asks the user to input the sentences by dragging and copying. Figure 1 shows Search Window, Selection Window and User Modeling Window.

2.4 Experimental Evaluation

To evaluate the effect of the division of Web pages, we compare performances of WebFALCON for two types of hypertext, one is composed of divided pages and the other is composed of undivided pages. The former database includes 11,702 undivided pages and the latter database includes 50,633 divided pages. The divided pages were generated from the undivided pages by using HTML tags. Then, CSF(here, r=0.6 in Equation-2), was compared with other two ordering methods, (b) r=0 (browsing context is not considered) and (c) r=1 (every page has the same influence to the current user interest). We ask twelve real users to browse with WebFALCON. Each user browses every combination, that is, six times.

The results are shown in Table 1, 2, 3, and 4 (scoring procedure is the same one referred in [Hirashima 98]). CSF for undivided pages, is not significantly better than other methods, but for divided pages significantly better. These results mean that CSF is effective for divided Web pages by using HTML tags, although it is not effective to raw Web pages.

3. Conclusion Remarks

This paper described a project to apply CSF for browsing in Web pages. CSF is based on well-formed hypertext, such as CD-ROM encyclopedia. To realize CSF for Web pages, modification of Web pages is required. We confirmed that CSF performed effectively by dividing Web pages with HTML tags. Improvement of division methods and large-scale experiment of WebFALCON are our future works.

References

T.Hirashima, N.Matsuda, T.Nomoto, J.Toyoda(1998). Context-Sensitive Filtering for Browsing in Hypertext, Proc. of IUI98, pp.119-126.

Search Window
Selection Window
User Modeling Window

Figure 1. Interface of WebFALCON

Table 1. CSF vs. Ordering Medhodb(r=0) for undivided pages

	r=0.6	r=0.0	two-sided sign test
The numbers of times when the score of one method is larger than the other	16	13	p = 0.71

Table 2. CSF vs. Ordering Medhodb(r=1.0) for undivided pages

	r=0.6	r=1.0	two-sided sign test
The numbers of times when the score of one method is larger than the other	13	16	p = 0.71

Table 3. CSF vs. Ordering Medhodb(r=0) for divided pages

	r=0.6	r=0.0	two-sided sign test
The numbers of times when the score of one method is larger than the other	21	9	p = 0.04

Table 4. CSF vs. Ordering Medhodb(r=1.0) for divided pages

	Sorting Method-1	Sorting Method-4	two-sided sign test
The numbers of times when the score of one method is larger than the other	22	8	p = 0.02

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Experiences with Real-time Streaming Audio/video in Delivering Web-based Courses

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Abstract: Over two years of experience with the application of real-time streaming audio and video (RealAudio/Video) to Web-based courses has yielded a wealth of experience in synchronous delivery of live instructional content and asynchronous delivery of archived content. Outcomes include:

1. Live broadcast
   a. Audio/video lecture content
   b. Visual aids "pushed" to remote viewers
   c. Chat feature for remote audience participation
2. Archived lectures with the soundtrack synchronized with the Web pages displayed during the live lecture (Synchronized Multimedia)
3. Multimedia annotations of Web page links including:
   a. Explanation of examination questions and answers
   b. Motivational messages to explain Web pages
   c. Oral instructions for assignments

An example of a course with these features can be found at: http://oncourse.iu.edu/in/ (select semester Fall 1999, enter "B684" for "Find a course" and log in as guest)

Products of this experimentation include:

1. User interfaces for:
   a. live broadcast
   b. archived lectures
2. Productivity tools for:
   a. constructing Synchronized Multimedia content
   b. creating voice annotations
c. Economical classroom premise equipment for originating live broadcast and encoding archived lecture

What is RealAudio/Video?

The RealNetworks Basic Server, RealEncoder, and RealPlayer comprise the RealMedia System created by RealNetworks (1997). The RealNetworks Basic Server streams files created with the RealEncoder to *free* RealPlayers on sound card-equipped personal computers, which continuously decompress the audio and play it in real time without download delays, even over 14.4 Kbps modems.

RealAudio has been widely deployed on the World Wide Web especially to distribute news and music as described at the RealGuide (1998) site guide. More recently, RealVideo has added video capability to RealAudio within the RealMedia architecture. Educational applications have become more common and examples can be found at RealNetworks' (1998) education page.

Experiments with RealAudio

Beginning in September 1996, Introduction to Data Processing (CPT 115) broadcast lectures *live* from Indiana University Purdue University Indianapolis (1996) via RealAudio. In addition, the lectures were archived on the Web site. As a result of this audio content being available, the Web site was significantly enhanced by the addition of voice annotations and oral instructions for assignments. Voice annotations were used to provide motivational messages to explain Web pages such as the one at:
http://www.engr.iupui.edu/cpt/courses/cpt299/1997fa/it/itaids.html

During the Spring and Fall 1997 semesters, Internet Skills (CPT 299) at Indiana University Purdue University Indianapolis (1997) continued the experiment by using Synchronized Multimedia to synchronize the lectures with visual aids on Web pages. Most of the lectures on http://www.engr.iupui.edu/cpt/courses/cpt299/1997fa/tcs.html have been synchronized. An example of Synchronized Multimedia by Thomas I. M. Ho (1997) explains this experiment in greater detail. To *experience* it, one will need:

- A personal computer with sound card
- An Internet connection with a speed of 14.4 Kbps or better
- RealPlayer 5.0 (free to download from the RealNetworks Web site at www.real.com)

In addition, voice annotations were used to explain examination questions and answers on http://www.engr.iupui.edu/cpt/courses/cpt299/1997fa/tcs.html

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Experiments with RealVideo

Beginning in January 1998, Electronic Commerce (CPT 423) broadcast lectures *live* from Indiana University Purdue University Indianapolis (1999) via RealVideo. Origination of live broadcast and archiving were accomplished via the ClassCast project developed by the CyberLab (1997). In addition, the archived lectures were significantly enhanced by the addition of "highlighting" which draws the students' attention to lecture segments that the instructor emphasizes because they are important and likely to be tested in examinations. A red bar that appears above the visual aids that are synchronized to the sound track indicates highlighting. As a by-product of these "highlighting" events, the important segments are indexed in the archived lectures so that these segments are then subsequently hyperlinked to the correct responses in the examination key so that the student can play back the video clips in which the answer to the corresponding examination question was given. RealVideo requires an Internet connection with a speed of 28.8 Kbps or better.

Results of experiments

Products

The major products of this experiment include:
- User interfaces
- Productivity tools

User interface for archived playback

The primary user interface has been developed for playing back archived lectures synchronized to the Web pages displayed during the live lecture. An example at
http://weblab.iupui.edu/cpt/archive/archive.asp?course=499&sem=fall1998&sec=B554&date=0923&start=1:0:0&end=01:19:0:0
demonstrates the controls for the video/soundtrack with a frame for displaying the synchronized Web pages and another frame for displaying the highlighting visual cue.

User interface for originating live broadcast

The live lecture is broadcast to remote viewers via the ClassCast user interface [Williamson, 1999] with the following capabilities:
- Delivery of audio/video content
- "Pushing" Web pages displayed to students in the classroom
- Chat to enable remote viewers to ask questions and to participate in classroom "discussions"

A notable contribution of the ClassCast user interface for the instructor is its ability to "time-stamp" each mouse click while "pushing" Web pages to remote listeners. This capability has greatly facilitated the creation of event files for producing Synchronized Multimedia versions of the lectures for archived playback!

Another notable outcome is the fact that an ordinary classroom was equipped with the ClassCast originating equipment for *only* about $20,000! For this modest amount, this classroom can serve a *global* audience!

Another capability developed by the CyberLab (1998) is NetCast which enables RealAudio content to be originated (broadcast live and archived) from *anywhere* via telephone. This capability is convenient for originating lectures from home when the instructor is ill or even for delivering conference presentations at remote locations without traveling to the conference venue. Although NetCast is conceptually similar to the original RealAudio origination capability, NetCast has the additional capability of scheduling the encoder via the World Wide Web as well as equipping the encoder with "auto answer" rather than requiring human intervention to answer the phone when initially connecting to the encoder.

Experiences

This experiment has demonstrated that significant instructional content can be delivered via real-time streaming audio and video that can be received by a modest computing platform with no more than a 28.8 Kbps dial-up connection to the Internet.

An anecdote serves to remind us why it is so important for us to experiment! Our experiments with RealVideo have led us to consider whether RealVideo can be used practically to broadcast signing to reach deaf students. Remember that we first experimented with real-time streaming *audio* to enable us to reach students who could hear!

References

CyberLab (1997). ClassCast. [WWW document]. URL http://cyberlab.iupui.edu/CyberLabHtml/classcast.htm
CyberLab (1998). NetCast. [WWW document]. URL http://netcast.iupui.edu
Ho, Thomas I. M. (1997) How We Do RealAudio [WWW document] URL http://weblab.iupui.edu/ho/cpt299_f97/lecture_frame.html?10179?
Indiana University Purdue University Indianapolis (1997). Internet Skills (CPT 299), Fall 1997 Web site [WWW document]. URL http://www.engr.iupui.edu/cpt/courses/cpt299/1997fa
Indiana University Purdue University Indianapolis (1999). Electronic Commerce (CPT 423), Web site [WWW document]. URL http://oncourse.iu.edu/iu/ (select semester Fall 1999, enter "B684" for "Find a course" and log in as guest)
RealGuide (1998). Web site [WWW document]. URL http://www.real.com/realguide/index.html
RealNetworks (1997). Web site [WWW document]. URL http://www.real.com
RealNetworks education page (1998). Web site [WWW document]. URL http://www.real.com/solutions/classroom/casestudies/index.html
Williamson, David (1999). A Template for Web-Based Interactive Distance Learning. Fifth Americas Conference on Information Systems, 1999, Association for Information Systems, Atlanta, GA.

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Innovative use of IT to support Competency Based Learning Paradigm – The Ngee Ann's Perspectives

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Abstract

Through the years, Ngee Ann Polytechnic, Singapore, has embarked, experimented and implemented several strategic initiatives to take advantage of the sophistication and advancement in Information Technology (IT) to enhance the teaching and learning environment on the campus. The lessons learned thus far have propelled the polytechnic into establishing innovative learning environment to support changes in education paradigm. This paper presents the Competency Based Learning paradigm and addresses how IT has been integrated to support the teaching and learning activities in a pervasive manner at the polytechnic. The conceptual model and framework for the implementation of the mentioned paradigm that make innovative use of IT will be presented. Key initiatives such as the use of Smart Lecture Theatres, Smart Laboratories, Computerized Tutorial and Assessment Classrooms, Multimedia Digital Repository, and Notebook Computing infrastructure will be discussed. The talk will report the findings on the impact of these infrastructures and their implications. The talk will also discuss and highlight the various problems encountered.

Introduction

The management of Ngee Ann Polytechnic advocated the notion of competency based learning paradigm to improve students' learning and instruction. The revolutionary approach aims to increase passing rate and to achieve a near zero or zero defects student population in the next millenium. Programme involved the use of IT has been put in place since April 1997 and there have been much encouraging results.

The Model

In the new education paradigm, all students must achieve a criterion set of competencies in the under-study module prior to the examination. By attaining the pre-specified criterion they would deem to have passed the module. This will then be served as a pre-qualification for them to take the final examination in the module, which would be used for grading purpose. In practice, this criterion set is generally translated into marks scored by the students based on their performance on project works, assignments, laboratory works, tutorials and/or tests. The percentage distribution of marks for the criterion would differ from one module to another.

Given that if all modules have been reviewed and re-designed to address the above and implemented accordingly, it is envisaged that the shift in paradigm towards competency based learning would improve passing rates and eventually contributes towards the objectives of achieving a near-zero attrition rate. This also implies minimizing the number of repeating students for any single module. In principle, it is understood that majority of students who have studied, completed their tutorials and all other course works progressively would do well in the module. This is based on the assumption that, during the process, learning takes place and that the students master what they have learned, develops the necessary skills and are able to apply them whenever necessary.

Information Technology Infrastructure

Key Information technology infrastructures such as Smart Lecture Theatres, Smart Laboratories, Computerized Tutorial and Assessment Classrooms, Multimedia Digital Repository, and Notebook Computing have been amalgamated into supporting the campus wide implementation of the new education paradigm.

The Smart Lecture Theatres enhance lecturers' presentation through the use of multimedia, gauge and pace their teaching to large groups through simultaneous feedback in real-time. The added benefit of this student-teacher interaction, mediated through the computer, is that students are less inhibited and more involved in the learning process. The Smart Laboratories or virtual laboratories provide students with the convenience of carrying out an experiment numerous times with varying parameters. Less time is spent taking measurement and calculating and leaving more time to focus on results and key concepts. The Computerized Tutorial and Assessment Classrooms are outfitted with powerful software systems enabling students to do their tutorials and assessments interactively. Students are not restricted to working on tutorials in the new classrooms but are able to access "electronic" tutorials from home or other remote sites. The Multimedia Digital Repository is a one-stop web site in which teaching staff could have access to shared multimedia components for developing their instructional materials. Likewise students could also access to them for their project works. To date, our classrooms have already fitted with network points and/or wireless point to support Mobile Computing communities on the campus. Such classrooms of the future could be located in such diverse places as a corner in a canteen or the library, as well as any other virtual environment that students and lecturers might gather.

Summary

The above summarized our competency based learning paradigm and provided a representative view on how IT has been adopted to support the implementation at our polytechnic.

Reference

[Tan & Lua 98], TAN Hock-Guan & LUA Seu Kea, Development and Implementation of NP-ONE multimedia Learning Architecture, Proceedings of 10th World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications

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Where To Build A Tide Power Plant?- Cooperative Learning On The Web

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Abstract

The article presents the implementation process of developing web-based courseware which was used to cultivate high school students' problem-solving and communication skills through cooperative learning. Students completed some exercises which help them learn the relative concepts of "tide" before they were grouped to solve a problem which presented energy crisis and required them to choose a place to build a tide power plant in Taiwan. Learning activities were delivered through web, and students' learning processes were tracked using network technology. Analysis of students' learning paths and communication protocols shed a light on how students sought and shared information in order to solve a problem.

Introduction

We are living in an era in which information virtually grows fast every day, work requires higher and higher information skills O'Leary, 1998 . Learning and teaching cannot come from books alone. The needs of learning include the ability to process information systematically, to read complicated diagrams, to solve problems effectively, and to communicate with others conveniently. To create a learning environment for these needs, a cooperative learning method needs to be embedded in a web-based courseware.

Three general cooperative methods are used in many research fields and adaptable to most subjects and grade levels: Student Teams-Achievement Divisions (STAD), Teams-Games-Tournaments (TGT) and Jigsaw II (Slavin, 1996). STAD is used in this study to promote effective learning. According to STAD, students need to help their teammates in order to make their teams succeed. The only way for the success of the team is for all teammates to master what they are learning. Students' achievement scores are added by individuals' scores and team score based on students' improvement over their own past records.

STAD was embedded in the web-based courseware. Although individuals' cognition, social contexts of learning tasks and cultural contexts affect individuals' learning (Bronfenbrenner, 1993), researchers can focus their studies on one or more levels at a time (Marshall, 1996). This study serves as a preliminary investigation of one Internet-accessible lesson based on a model of cooperative learning. The purpose of the study was to address how individuals' immediate social context impacts on their problem-solving processes.

Learning Activities

Once the conceptualization of learning is as a simple case of knowledge transmission from expert to novice. With a paradigm shift, the rationale for learning emphasizes the social construction of knowledge (Vygotsky, 1978). Cooperative learning increases dialogue among students and potentially promote students' comprehension and knowledge. Networks can provide a powerful means to surmount the barriers that make shy or slow students fail to communicate with others. A web-based lesson, named "Where to build a tide power plant?", has been developed to support cooperative learning. This lesson allows students to explore the relative concepts about tide using raw data and animations. After complement of several exercises, students work on a project cooperatively using tide data and geological information of several locations in order to make a decision where is the best place to build a tide power plant in Taiwan. Since there is no fixed answer for this problem, students' tasks are to provide enough reasons and explanations about their final decision. Learning activities were delivered through web, and students' learning processes were tracked using network technology. The records of students' learning paths and communication protocols help researchers understand how students sought and shared information in the problem solving process.

Conclusion

The strength of this study is to design a cooperative learning environment using network techniques in order to cultivate students' problem-solving and communication skills. Higher ability students can help other students work on a project. The success of cooperative learning requires all members in a group to contribute their efforts. STAD counts the success of a team using the score based on students' improvement over their own past records. This motivates higher ability students to assist other group-mates master learning materials and reduces lower ability or passive students' frustration when they work on a complex problem alone. In order to keep engagement and motivation, a reward should be announced when students just starts their learning activity. Students who are not familiar with cooperative learning methods will not get optimal benefits from this setting. The training of communication skills and cooperative learning methods are needed before students use this lesson.

References

Bronfenbrenner, U. (1993). The ecology of cognitive development: Research models and fugitive findings. In R. H. Wozniak & K. W. Fischer (Eds.), Development in context (pp. 3-44). Hillsdale, HJ: Lawrence Erlbaum.

Marshall, H. H. (1996). Implications of differentiating and understanding constructivist approaches, educational Psychologist, 31, 235-240.

O'Leary, A. (1998). Get-Wired - Go Digital: Build a Web Based Learning Community. 1998-9 WebNet Journal.

Slavin, R. E. (1996). Cooperative learning- theory, research, and practice. (2 nd Ed.). Boston, MN: Allyn and Bacon.

Modulo: Development and Evaluation of an Interactive Multimedia Education Concept for the Subject "Fundamentals of Computer Science"

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Abstract: It is often criticized that university education is too inflexible and does not go enough into the needs of individual students. As part of the restructuring process of university education which includes using the new forms of media, a new education concept for the vocational teaching profession "Computer Science" is presently being developed at the Gerhard-Mercator University of Duisburg. The aim of the MODULO Project is to create new possibilities of differentiated and decentralized learning. The new didactical concept of this course should take the different learning needs of the students into account. Therefore a teaching concept has to be developed which considers the heterogeneous educational background of the students and also offers students different degrees of preparation, accompaniment and practice. Finally the new didactical concept should promote a media competence for the to-be teachers, which is based on multimedia related learning and teaching methods, so that these contribute in their later practice to new teaching and learning forms.

Introduction

The subject "Fundamentals of Computer Science" at the Gerhard-Mercator University of Duisburg is an important basic offer for different degree courses, for example the German "Diplom Ingenieur" course "Electrical Engineering", the vocational teaching profession "Computer Science" as well as the new Master of Science degree course "Computer Science and Communication Engineering" which was introduced in the winter-semester 1997/1998.

Since every student has his own learning needs, the basic knowledge of computer science varies dependent on the students background. The vocational teaching profession especially deals with students of different background. The professional field "Computer Science" can be chosen as a secondary or specialized professional field with the combination of different main professional fields, for example mechanical engineering, chemical engineering or professional fields like textile and clothing engineering. Likewise students who are enrolled at another university have the possibility to take their secondary professional field at the Gerhard-Mercator University of Duisburg.

Taking this facts into account, a teaching concept has to be developed, which

- considers the heterogeneous educational background of the students,
- offers students different degrees of preparation, accompaniment and practice
- and gives students who are not enrolled at the Gerhard-Mercator University of Duisburg the chance to follow the courses at home, and thus reduce the need of travelling to a minimum.

Students following technical courses and especially those who are following a teaching profession, need to deal with multimedia teaching and learning methods. Furthermore, it is expected these to-be teachers have already acquired a media competence during their university education, so that they are able to handle new teaching and learning methods using the new media.

Concept and Structure

The concept of the interactive multimedia teaching and learning software is built up in such a way that the different learning methods of the students are taken into account. It is build in a modular way in order to obtain the possibility to adapt it to new needs. This concept follows a general set up, implementing the subject structure or script of the lecture "Fundamentals of Computer Science". Here the theories and methods are imparted, for example switching algebra, finite state machines or micro-programming. Starting with some basics the topics are presented in a linear way. There are also links between all topics, but this is more or less a linear structure. Every topic holds some graphics and interactive animations for explaining and illustrating the contents. Multimedia based animations can explain technical things often better than a textual description. This is the traditional way of developing multimedia based teaching software. In addition this concept contains an exercise module, where students have the possibility to test and apply the learned methods. So the students also have a self-control. The exercise module is directly linked up with the script module.

The innovation of this concept is the third module, which represents a second starting point of the learning software. This so-called scenario enables a learning goal oriented or rather problem based learning by offering a structure which is based on an example taken from a real life development. Here, for example the development of a production robot is given as a task. The scenario is linked again to the exercises, but not in a linear way like in the script, but based on the problem given through the task. This form of learning should provoke curiosity and activates the educational background of the students. It is again possible to switch from the exercise to the script module in order to look up necessary information. For each main professional field a scenario will be developed, so that the students can identify themselves with it.

In addition to this concept, an information system is developed, which is supposed to deepen and strengthen the knowledge concerning the already mentioned emphasis. It includes a glossary of the most important technical terms, some data sheets as well as pictures and videos of the production and use of IT-components.

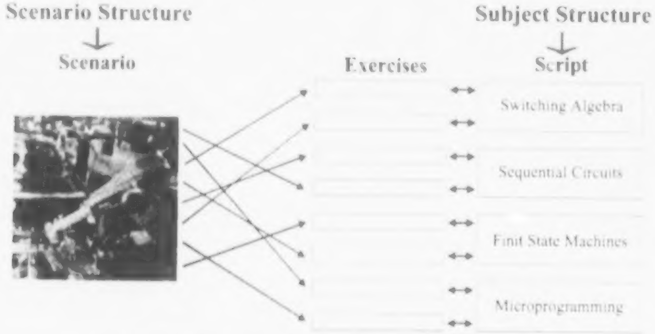

Figure 1: Structure of the MODULO Concept

Students are used to work with heterogeneous platforms like Windows 95/98, Windows NT, Apple Macintosh or Linux. That's why the implementation of the software is done by HTML in combination with Java Script and Macromedia Director. This ensures platform-independence and enables the access via the internet. The user just needs a Java Script-able browser like Netscape or Internet Explorer Version 4 or higher with an installed Shockwave plug-in.

Conclusion and Prospect

In this paper a new concept for the support in the teaching of the subject "Fundamentals of Computer Science" was presented. The aim of this concept is the media technical processing of the course, the development of suitable scenarios and the development and implementation of a WEB-Database with dynamic access. This concept allows, thanks to its modular design, to go in on the individual requirements, states of knowledge and learning methods of the students. It allows a self-controlled learning, promotes media competence and offers comprehensive possibilities of acting. The modules can be adapted easily to respective requirements. The scenario is exchangeable and can be adapted for each professional field. A first development phase accompanying evaluation leads to positive results and constructive criticism. The complete system should be ready by September 1999 so that an extensive evaluation can begin during the winter-semester of 1999/2000.

Creating a Web-Based Learning Community: CalState TEACH

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Abstract: Governor Gray Davis and CSU Chancellor Charles B. Reed unveiled CalState TEACH April 28 in Sacramento. CalStateTEACH offers a new approach to earning a California teaching credential by addressing the needs of the 15,000 California elementary teachers now working with emergency permits. Tailored to meet the problems of working teachers with scheduling difficulties, family commitments and limited time, this visionary program combines print material, tapes (audio and video), email and the Internet and periodic Saturday seminars with field-based learning in elementary classrooms with support from CSU faculty. Modeled after the successful British Open University, the CalState TEACH curriculum was designed by a team of 30 CSU faculty members from virtually all CSU campuses to prepare working teachers to meet California teaching standards. This paper highlights the collaborative efforts of the technology team to infuse technology throughout the curriculum and assure compliance with state and national technology competencies for teacher candidates.

Increases in elementary school enrollment along with class-size reduction and teacher retirements have multiplied the demand for teachers. The chronic shortage of teachers in California is especially acute in urban districts. California's urban districts have the largest proportion of emergency permit teachers with Los Angeles Unified School District facing the most serious shortfall of credentialed teachers. Designed to meet the immediate need for qualified teachers, CalState TEACH combines independent study at home via the Internet with personalized supervision by school-based mentors and visiting specialists from the CSU campuses. Offered in four stages over an 18-month period, CalState TEACH recognizes that a working teacher has little time to commute to his or her closest CSU campus. Unlike traditional campus-based courses, CalState TEACH is centered at its five regional centers throughout the state. Beginning teachers are supervised by CSU faculty members who provide advice and support as they observe them in action. Partnering with school districts throughout California, veteran teachers from the credential candidate's own districts serve as mentor.

CalState TEACH supports independent learning, where students can study at their own place and time, without the need for class attendance. Using email and the Internet students can receive and submit assignments, question professors and discuss the program in special chat rooms. Although the delivery technique is innovative, the rigorous nature of the credentialing process is not. Assignments due dates and testing are all elements of CalState TEACH. Applicants are expected to commit at least 12 hours per week to complete the program successfully.

Assembly Bill 1023 (Mazzoni, Chapter 404, Statutes of 1997) requires that California credential candidates meet certain preliminary minimum standards relative to the effective use of computer-based technology in the classroom prior to receiving a *Preliminary* Multiple Teaching Credential. Additional standards must be met before receiving the *Professional* Multiple Subject Teaching Credential. The full report containing the recommendations of the Commission's Computer Education Advisory Panel for the implementation of AB 1023 can be found at: http://www.ctc.ca.gov/aboutctc/agendas/December%201998/prep/prep2.html#TOC

A team of educational technology specialists was selected to assure CalStateTEACH compliance with these technology standards. Each specialist was assigned to one of the four curriculum content teams with the task of infusing technology throughout the curriculum. The technology team met regularly to gather, preview, discuss and select relevant software materials and WWW sites. The appropriate and efficient use of software applications and related media to access and evaluate information, analyze and solve problems, and communicate ideas was considered essential to maximizing the instructional process for the interns. Such use of technology supports teaching and learning regardless of individual learning style, socio-economic background, culture, ethnicity, or geographic location.

To help candidates become fluent, critical users of technology and to help them develop the technology skills necessary to succeed in the program, a CalStateTEACH Technology Guide was created. It provides essential resources to help candidates develop the confidence and ability to use technology effectively in their teaching. Most importantly, it inspires candidates to continue using and exploring technology to facilitate their own learning, to increase professional productivity, and to expand their own capacity to use technology for creative growth.

The education, techniques and feedback that the CalStateTEACH credential program offers can tip the balance between success and failure, staying in the profession of teaching or leaving it. A field-based credential program firmly grounds the novice teacher in the mechanics of learning the hows and whys, what works and what doesn't. The pervasiveness of incorporating computer-based technology regularly through out the 18 month learning experience has educational implications. Since quality teaching is the most important predictor of a child's educational success, helping teachers succeed by earning a teaching credential benefits the teacher, students, and the school. The CalStateTEACH program is the equivalent of 39 semester units. Participants who complete the program will receive a Multiple Subject teaching credential (elementary) with an emphasis in Crosscultural, Language and Academic Development (CLAD), as well as immersion in a technology-rich learning environment.

References:

Dexter, S., Anderson, R., and Becker, H. (1999). Teachers' Views of Computers as Catalysts for Changes in Their Teaching Practice. *Journal of Research on Computing in Education*. 31. 221- 239.

Ragan, L. (1999). Good Teaching is Good Teaching: An Emerging Set of Guiding Principles and Practices for the Design and Development of Distance Education. *CAUSE/EFFECT Journal*. Volume 22 Number 1. (On-line). Available: http://www.educause.edu/copyright.html

President's Committee of Advisors on Science and Technology (March 1997) Report to the president on the use of technology to strengthen K-12 education in the U.S.

Johnson, J. (1997). It takes a (Global) Village to Prepare Teachers: Teaching/Technology/Reflection. Jack Chambers. (Ed.). Selected Papers from the *National Conference on College Teaching and Learning* (8th Jacksonville, Florida, April 16-19, 1997).

Design Of An Interactive Forum Environment Tailored For Distance Education

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Abstract : Forums are frequently used in distance leaning platforms in order to make easier the exchange of ideas between students and tutors. But, frequently, the huge number of available contribution limits the use of newsgroups as real work groups. This communication introduces a work, in progress, which aims at making contacts easier in a distance learning newsgroup, by the integration of tools which collect contributions in the form of cases and which are able to evaluate similarity between cases.

1 Introduction

The aim of this paper is to describe a work in progress, about an interactive communication forum dedicated to Distance Learning. On the web, newsgroups constitute a privileged way to confront experiences, in spite of a still weak interactivity [Dessus, et al., 97]. Thus, when a user wants to make an intervention in a forum, the main problem he can find is the number of questions raised and their heterogeneity. In the context of an asynchronous forum, a majority of participants adopt the solution to give themselves a contribution, instead of trying to make contact with somebody who has previously related a similar experience. These reasons justify the interest of a functionality allowing to structure the expressed knowledge and to help drawing links between students who have similar experiences.

In the context of a distance learning action , the integration of this kind of forum constitutes an additional value that allows students to interact with the tutor and with other students. Such a forum can, for example, take all its interest in the context of the medical lifelong learning. In fact, for this kind of training, discussion workshops arise, in which significant experiences are mentioned. The site of "Arrakis Formation Medicale Continue", managed by Dr. Tusseau [Tusseau, 98], presents some examples of this kind of meetings and reports about previous meetings. Regular work sessions on interactive discussion forums could tend toward the functions of these real meetings, with the advantage that some of the participants of the virtual group could not have the opportunity to take part in a real one. This situation, obviously applies in a great lot of domains. This approach draw it's inspiration from both the concept of communication GroupWare [Dillembourg et al., 96] and the notion of collaborative learning ([Grudin, Poltrock, 96]).

The next chapter presents the actual work about the communication system and describes tools which are necessary to build it. We then conclude with the technical advancement perspectives and on the methods designed for the evaluation of this forum.

2 An interactive communication environment...

This section describes the proposed interactive communication forum and its main interactions. The presentation of the tool dedicated to collect different experiences and to emphasize similarities between them gives then an idea of the implementation approach.

This system is an application of the Case Based Simulation model elaborated by D. Leclet and G. Weidenfeld ([Leclet, Weidenfeld, 96] [Leclet, 98]), which is inspired by Case Based Reasoning methods ([Koldener, 93] [Schank, 82]). This model considers a *case* as a scenario, an experience illustrating a precise pedagogical objective. The case description lean to a lower model layer in which all the entities, acting in the case, are represented by an object formalism. A particular structuring of the case base allows the constitution of interactive environments, based on similarity between cases.

A distance learning student contribution in a forum is considered as a case that this student will be able to annotate and to structure, using an adapted representation of the domain and of the activity. To collect the contribution, a design and implantation work of a generator has been put in place. It is a matter both to build an intuitive and supple environment in which experts will be able to describe their experiences and equally to give to this tool some structuring means of the obtained case base. This tool will be used, at first, by experts in order to formalise the domain and, later, everyday by students in order to relate their own experiences in their activity practice. The tool will then be considered as the heart of the interactive communication system devoted to the distance learning community.

So, the interactive communication forum general architecture is centred around an case base tailored for the collection of different related experiences. At the beginning, the initial case base is established by a domain expert group. Once this base is constituted and structured, it gives to each forum participant the possibility to relate a new case under a standardised formalism. This will help other participants, among which the tutor, to make connections between experiences having some kind of similarities. Parallels may be relative to the comparison of new experiences with initial experiences, or between new experiences. Once a relevant parallel is realised, the system informs the students which are involved.

The following paragraph concludes over the development perspectives and on the means considered to estimate and validate performances of this kind of forum on a distance learning platform.

3 Conclusion and perspective

This paper present a new application of the "Case Based Simulation" model, applied to the design of an interactive distance learning forum. The need of improving forum interaction in the context of distance learning is patent, thus the first perspective for the present work will be experimentation in effective contexts. These actions will allow, in fact, to obtain important returns of information on behalf of authors, tutors and users. The analysis of these information will enable new specifications and hence a new tool version and a solid similarity assessment method. Afterwards, the pedagogical validity of this forum will must be established by confrontation with different student groups, by the comparison of interactivity in sessions both in place and at distance, and after all by statistical calculus of a satisfaction clue established with a questionnaire given to each speaker. The combined analysis of the obtained results will allow to assess the pedagogical interest of this kind of forum and the interaction validity between all the forum actors.

References

Dessus P., Lemaire B.t, Baillé J.(1990), *Experimental Studies on Distance Teaching and Learning (in French)*, Sciences et Techniques Educatives, volume 4, n°=2 p137 - 164.

Dillenbourg P., Baker M., Blaye A., O'Malley C.(1996) *The Evolution of Research on Collaborative Learning*, in Spada and Reimann (Eds.) Learning in Humans and Machines.

Grudin J., Poltrock S. (1996) *CSCW, Groupware and workflows : Experiences, State of Arts and Future Trends*, Tutorial in Proceedings of CHI96, Vancouver, British Columbia, Canada.

Kolodner J. (1993) *Case Based Reasoning*, Morgan Kaufman.

Leclet, G. Weidenfeld (1996) *Un modèle de simulation basé sur une représentation de type "objets - règles" pour l'enseignement des métiers de vente*", ITS 96, Montréal.

Leclet D (1998) *A learning system for rheumatology on internet"*, ED-MEDIA 98, AACE Conf. , Freiburg.

Schank Roger (1982) *Dynamic memory : a theory of reminding and learning in computers and people*, Cambrige University Press.

Tusseau M. (1998) *"ARRAKIS, Formation Médicale Continue", site http://www.arrakis-fmc.com.*

Enabling Inter-net Students to Enthusiastically Compare Cultural Values

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Abstract: By comparing different cultural values through e-mail Correspondence, classroom connections and discussion, direct interviewing, and playing the web-net game called VESAX to discover where they stand on a culturally different value scale which compares a common westerner with a common Japanese, students learn to communicate better, while removing some of their prejudice and invalid assumptions to view themselves and their own culture objectively, and to internalize global values through discovery-learning and enlightenment.

Two of our seminar students, who had joined a home-stay program in California State, mentioned that the family they stayed with often made use of fast foods as a main part of their meals. They generalized that most American people have such an eating habit. They felt that making use of fast foods was the typical American style. The writer responded that they should not jump to such a conclusion. Later they found that none of the family members they stayed with were college graduates. Does an eating habit have to do with higher education among the people of the United States? What about Japanese people? These questions were not such a great discovery for them after their home-stay experiences, but they became the beginning of their quest activity for the writer's seminar class on "Culturally Different Criteria for Decision-making."

Through the students' survey between Himeji Dokkyo University in Japan and S. University in the United States, they discovered that Japanese students would make use of fast foods more than American students in a given situation. They also learned from the newspaper that an organically grown vegetable garden in the grounds of a public junior high school in the suburbs of San Francisco, which used to be a "blackboard jungle," positively influenced both the children's physical health and their mental health. With Alice Water's comment on a definite relationship between a vegetable garden and calm minds they also learned that there are now similar vegetable gardens in more than 1,000 public junior high schools in California (1998). They realized that some of the assumptions they make about overseas people could be mere prejudice and that they should not make a judgement unless they do some research on what they are discussing.

In the seminar class each student first thinks up a specific situation with two or three ways that an individual might react in the situation. Second, he or she collects data by asking two groups of students. The subjects of the first group, Japanese students, are from Himeji Dokkyo University, and the subjects of the second group, overseas students, are found through e-mail either from the world Pen Pal lists or e-mail classroom connections. Third, they analyze the data to find out whether the two groups have culturally different criteria for decision-making, using the chi-square table. Fourth, they put their results up on the web site under Culturally Different Criteria for Decision-making. Fifth, they discuss the results with overseas students through e-mail corresponding or sometimes by interviewing overseas students. And finally they make presentations in class, demonstrating the English communicative skills they have gained as a byproduct. The survey results have turned out to be so interesting that we have made a simulation game (VESAX Virtual Edutainment Systems using Active-X) to show that if what they discover is so fascinating, their enthusiasm will go up, too.

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These seminar classes are not enough to show the efficiency of the classroom activities empirically, but as case studies they seem to be sufficient enough to show that the class projects are highly motivating as well as instructive for the students. After gaining some confidence in English communication through e-mail corresponding, some of the students actually went to overseas countries and interviewed some students there, which really enlightened their thoughts. They were surprised to find out that the overseas students were very interested in the project and felt happy responding to their interview after seminar students explained why they were doing this project. As e-mail classroom connections, the seminar classes could contact some inter-cultural classes and cultural Psychology classes in the United States. The teachers in charge of these classes and the class leaders of those classes were happy to send the responses and comments of their students since the project mutually benefits both sides.

In the VESAX, one can realize a common Japanese and a common westerner's decision-making tendency the outcome by the size and shape of the globe which appears every time you click the result icon box. One can also realize where he or she stands in comparison with both common Japanese and common westerner decision-making after responding to the questions, or checking A or B or sometimes C in every three questions under six criteria: (1) Growth of the Enterprise in terms of the People's Work, (2) Individual Care in the Enterprise and the Society, (3)Various Aspects of Development throughout the Society, (4)Fair Opportunities for Business and Employment, (5)Satisfaction of Family Members in terms of Having a Good Life Together, and (6)Growth of the Enterprise and Society in terms of Information Flow with the People's Understanding. The VESAX shows that if you are a common Japanese, you may be working very hard and taking good care of only those who are really close to yourself due to so-called personal connections, but that you do not grow in various aspects much. The result is an uninteresting society, only a few chances for good business and good employment, sacrificing your time more for work instead of having more fun time with your family, and trying to do your best to conceal something obnoxious for face value. The end result is that the globe crashes as if you felt completely frustrated and your life became extremely uncomfortable and unhappy. Through the VESAX one can realize that common Japanese decision-making does not lead to creating a wholesome society. Of course, there are some negative sides in almost all cultures. But realizing them in one's own culture and trying to improve them as an individual through personal decision-making means a great deal to any Japanese individual who plays this game. The goal for the VESAX is not to reject all Japanese cultural decision-making elements but to enable each student to see things more with international views and more with global values as a result of discovery-learning and enlightenment comparing value systems of several cultures.

The VESAX is the tool for students to see cultural differences while looking at the shape and size of the globe. Since it is difficult to look at yourself and your decision-making objectively, if you are inside the box of a particular culture, this simulation game helps you.

Throughout the seminar course on Culturally Different Criteria for Decision-making, as a whole, the students did gain enthusiasm in aggressive English communication. Also the web-net game called VESAX has enabled the players to understand cultural differences without going to overseas countries and has provided them with the chance to reconsider their priorities and values. Not only the seminar class students have grown enthusiasm in developing their research on the theme, Culturally Different Criteria for Decision-making; also overseas students found it quite exciting to discuss the contents of the web sites, (http://www2.gol.com/users/arise0mk/) and (http://www.sys.wakayama-u.ac.jp./~shima/call/), and to discuss them through e-mail correspondence. This study certainly demonstrates how the students developed aggressive English communication for discovery, enlightenment, and global values by comparing culturally different values for decision-making through the inter-net.

References

Asahi Evening News, March 18, 1998. "Vegetable Gardens help calm the mind."

Formative Evaluation of an Evolving Web-Based Digital Archival System

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Abstract: ISLA (Information System on Los Angeles) allows access to a wide variety of archival information of a geographic region in multiple formats (textual, qualitative, photographic, spatial, audiovisual) from all historical periods. A number of issues have been raised in the project's implementation which call attention to the need for a formative evaluation of the evolving web-based digital archival system. In this formative evaluation phase, several parallel systems with different interfaces and search capabilities, but with the same core of archival materials, are operating. These systems are being evaluated in terms of user-oriented dimensions using standard web evaluation criteria, and by measuring learner outcomes, attitudes, and employed teaching and learning strategies.

Introduction

Much information is gathered about metropolitan regions but access to and interpretation of these data is difficult due to the fact that the data are segmented into discrete entities. A group of interdisciplinary researchers, in collaboration with area institutions and community groups and various funding sources, have been developing a web-based digital archive system to allow a more robust analysis of a metropolitan geographic region. The basic concept behind this system is to allow access to a wide variety of archival information from all historical periods of a geographic region, linked by spatial and temporal coordinates. The primary, long-term goal is to create a system that will enable all kinds of users, from elementary school children to advanced researchers, to search and access a rich and diverse range of digital archival research materials in multiple format (textual, qualitative, photographic, spatial, audiovisual).

It has been noted that digital libraries can be considered some of the most complex and advanced forms of information systems due to the myriad of complexities involved (Fox & Marchionini, 1998). This has been the case with this digital archival system. A number of issues have been raised, including the fragility of a system which is 'leading" the technology, and the fact that users, such as students and non-researchers, may not have the capability to access a system with high-end computing requirements. There was the need for a formative evaluation of the evolving web-based digital archival system. The following describes the present system (ISLA), an alternative to this system (The Digital Library System), and the methods of gathering input from users on these systems. The overall purpose of this effort is to help refine the direction of the overall digital archive project.

ISLA

ISLA has two main components: 1) the user interface, an advanced Web application and known as IDA, or Integrated Digital Archive; and 2) a large database of materials, or ISLA. The system allows for space/time/fulltext/format indexing to search for and retrieve materials and, in addition, has the conventional indices of author, title, subject, and other cataloging fields. The materials/resources in ISLA include photographs, newspaper texts, aerial and satellite images, digital spatial data made available from Thomas Bros. Map Company and the Bureau of Engineering of the City of Los Angeles, and data from the 1939 WPA (U.S. Work Project Administration) and land use maps (Kazlauskas et al. 1997).

The Digital Library System (DL)

On a broader front, the university library has undertaken a more conventional (although not to mean less complicated and less useful) digital library initiative based on the IBM Digital Library Software. This is a more traditional library of digital objects that can be searched by keywords that are in the structured description of the item. This development is in the mainstream of digital library developments worldwide, such as being developed as UC Berkeley (http://www.storage.ibm.com/storage/customer/berkeley.htm) and the Russian State Hermitage Museum (http://www.ibm.com/ibm/ibmgives/hermitage.htm). In the meantime, another initiative using the University's WebCat interface is anticipated.

The Current Evaluation Project

Evaluation has always been a central component of this project. In this formative evaluation phase, we are operating and examining parallel systems with different interfaces and search capabilities, but with the same core of archival materials. The ISLA objects have metadata in their own format which contains keyword search fields but also the GIS information for the spatial and time searches. These items have been exported out of the ISLA library and imported into the digital library system (DL).

At present, we are conducting training sessions that present both systems to the 'trainees.' Upon completion of the training sessions, the trainees have the task of developing a curriculum lesson plan using the ISLA digital archival resources. Individuals included in this formative evaluation include master's degree students in instructional technology representing both the corporate and educational sectors, graduate students in education, and practicing K-12 teachers. Evaluation of the two systems is being conducted through the analysis of data generated from the investigation of the two major areas of interest to us: user-oriented dimensions, and student learning and student outcomes. The effort includes the use of a variety of data gathering techniques, including observations of learners, unstructured and structured interviews, and examination of student work.

We are basing our evaluation of user-oriented dimensions on standard web evaluation criteria, such as on framework for evaluating multimedia packages by Reeves and Harmon (1993) and that found at the Web-based Training Information Center (http://www.filename.com/wbt/index.html). Some of the dimensions are addressing include: ease of use, navigation, cognitive load, screen design, and content.

Evaluation of students is being accomplished by measuring learner outcomes, attitudes, and employed teaching and learning strategies. In addition, we are concerned with the motivating and engagement factors of the two systems, and the ability to link these systems to curriculum standards, such as the California Curriculum Frameworks and the national geography standards.

References

Fox, E.A. & Marchionini, G. (1998) *Toward a worldwide digital library*. Communications of the ACM. 41(4): 29-33.

Kazlauskas, E.J., Ethington, P., Wegner, L., & Hunt, Li. (1997) Learning with ISLA (Information System for Los Angeles). *Proceedings of the Society for Information Technology and Teacher Education (SITE) 1997*. Charlottesville VA: Association for the Advancement of Computing in Education. p. 1120-1122.

Reeves, T., & Harmon, S. (1993). *Systematic evaluation procedures for instructional hypermedia/ multimedia*. Paper presented at the 1993 Annual Meeting of the American Education Research Association (AERA). Atlanta GA: American Education Research Association.

Multipoint Multimedia Chatting and Collaboration Service

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ABSTRACT: Telecommunication companies and video/audio codec makers are actively participating in the standardization activities of multimedia conference over packet based network such as the recommendations of H.323 series. Development of some standards of multimedia conference is completed. Multimedia conference services for closed user groups like distance learning and company wide conferencing are provided.

In this paper, an implementation example of multimedia chatting service is described. A multimedia chatting service is developed in order to increase the popularity of multimedia service. A chatting participant of the system can simultaneously watch documents with remote people and change the content of the documents.

1. Introduction

Telecommunication and video conference related companies such as NTT, AT&T, Intel, and Lucent have given active contribution to standardization of multimedia conference. Multimedia conference standardization over ISDN is completed. Standardization over packet based network is being done with the active contribution by many companies. H.323 v1 and v2 were published as recommendations and H.323 v3 is being developed. Standards of multimedia conference is implemented and tested in IMTC. It is required to provide general multimedia conference service in order to increase the popularity for multimedia service.

Chatting service is a commonly well-known service. Features of multimedia conference like video/audio/data signal transmission can be adopted to current text based chatting service. Additional system component is needed to add new type of media stream other than text signal.

In this paper, an example of multimedia chatting service is described. Using multimedia chatting service, chatting participants dynamically make the chatting rooms, enter the rooms and do chat. Multimedia chatting system is comprised of a MCU(Multipoint Control Unit), MCU operation server, a chatting service server, a gateway and terminals. System configuration of Multipoint Multimedia Chatting service is shown in Fig1.

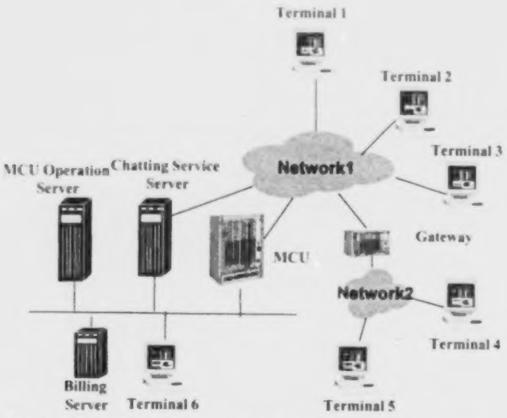
Terminal 1
Terminal 2
Terminal 3
Network1
MCU Operation Server
Chatting Service Server
MCU
Gateway
Network2
Terminal 4
Billing Server
Terminal 6
Terminal 5

Fig1. Elements of Multipoint Multimedia Chatting System

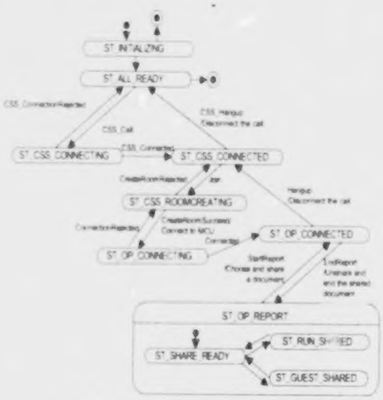
ST_INITIALIZING
ST_ALL_READY
CSS_ConnectionRejected
CSS_Call
CSS_Hangup
Disconnect the call
ST_CSS_CONNECTING
CSS_Connected
ST_CSS_CONNECTED
CreateRoomRejected
ST_CSS_ROOMCREATING
Hangup
Disconnect the call
ConnectionRejected
CreateRoomSucceed
Connect to MCU
Connected
ST_OP_CONNECTED
ST_OP_CONNECTING
StartReport
Choose and share a document
EndReport
Finish and end the shared document
ST_OP_REPORT
ST_RUN_SHARED
ST_SHARE_READY
ST_GUEST_SHARED

Fig2. The State Transition Diagram of a Main Control Class

2. Multimedia Chatting and Collaboration System

Terminal : A chatting terminal is a multimedia conference terminal that can communicate with a chatting service server and provide for real-time, two-way communications with other terminal. A chatting terminal establishes one connection with the chatting service server or MCU at a time or simultaneously builds two connections with both of them. A terminal asks the chatting service server to arrange a chatting room. After the chatting service server creates a chatting room, it notifies the terminal that a room is successfully created. When the terminal receives a message of room-created, it tries to make a connection to a MCU. The terminal can disconnect the connection to the chatting service server in order to use all bandwidth of the line in the connection to the MCU.

MCU(Multipoint Control Unit) : The MCU provides the capability for several terminals to do multipoint

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chatting. The MCU sets up a point-to-point connection with each chatting participant. The MCU receives video/audio/data streams and processes them according the type of conference. Then it distributes the stream to all terminals. It simultaneously shows several participants on a screen. The MCU consists of a mandatory multipoint controller and optional multipoint processors for audio/video/data stream. The multipoint controller(MC) controls terminals that participate in a chatting and provides for capability negotiation among terminals in order to determine common mode of conference. The multipoint processor provides for media stream mixing, switching.

Chatting Service Server: It manages the connections from terminals. It receives terminal-transmitted commands and processes them to manage chatting rooms. It also provides the directory service to send to each chatting participant the information of currently connected user. It has a registered user database and identifies the chatting service users.

MCU Operation Server: The MCU operation server controls the behavior of the MCU. It receives chatting room related commands from chatting service server. Chatting service users also can provide the preference for a conference like call setup method(call in/call out), video presence(video switching/continuous presence/transcoding).

Gateway : The gateway is connected to two different networks. It allows terminals that are connected to different networks to communicate. The gateway translates transmission format and communication procedure. It also translates video/audio/data formats into appropriate ones. But if media formats that are used in a conference are same, translation is not required.

Billing Server : A billing server retrieves log information called CDR from MCU and chatting service server.

3. Operation Modes of Chatting System

There are two operation mode, i.e. dual connection mode and single connection mode. In dual connection mode, a terminal simultaneously has two connections. One is to a chatting service server and the other to a MCU. A terminal can see how many chatting participants and chatting rooms there are.

In single connection mode, a terminal makes one connection at a time. Firstly, the terminal builds a connection to a chatting service server and asks a chatting service server to join/make a room. If a terminal is informed that joining/making a chatting room is allowed, the terminal disconnects from the chatting server and makes a new connection to MCU and do chatting. In this mode, the terminal can do document share. A chatting service server maintains the chatting participant list.

4. Development of the Service

In the case of developing several systems sharing similar functions, the formalized software development technique makes developer easily reuse the analysis and design result as well as source code of the system. Several multimedia conference applications are being developed. In this section, an example of multimedia chatting terminal is explained in which object oriented software analysis and design method is adopted.

In the iterating software development phases of design, analysis, implementation and maintenance, the relation of objects that compose a system is described by object model and the life cycle of the objects is represented by dynamic model.

Main control class of the chatting terminal software manages calls to MCU and Chatting Service Server. It has eleven states including 3 substates. A state 'ST_INITIALIZING' is initial state. When initialization of all controls including video/audio/data controls are completed, the state is changed to ST_ALL_READY. When a participant tries to connect to a chatting service server, the state becomes ST_CSS_CONNECTING. After 'CSS_ConnectionRejected' event is received, the state goes back to ST_ALL_READY. The state ST_CSS_CONNECTED indicates that connection is successfully completed. State change from ST_CSS_CONNECTING to ST_CSS_CONNECTED is occurred when CSS_Connected event is received.

When the 'join' command is transmitted from a participant, state is changed to ST_CSS_ROOMCREATING. When 'CreateRoomSucceed' event is transmitted by the chatting service server, the terminal tries to establish a call to MCU and the state is changed ST_ OP_CONNECTING. The state ST_OP_CONNECTED means the connection to a MCU is completed. When a chatting participant tries to hang up the connection, the state is changed from ST_OP_CONNECTED to ST_CSS_CONNECTED.

5. Conclusion

In this paper, an implementation example of multimedia chatting and collaboration service is showed. This system is designed to increase the popularity of multimedia service. A user of the system can simultaneously watch documents with remote people and change the content of the documents. In the development process, a methodological software development technique like object modeling technique is adopted to reuse the analysis and design result. The design result can be used in building another multimedia conference applications

Reference

[1] Sang Gil Kim, Young Sun Kim, and Sanghong Lee, "Implementation of Multipoint Multimedia Conference System for Electronic Document Interchange Using Object Modeling Technique," WebNet98 World Conference, Association for the Advancement of Computing in Education(AACE), November 1998.

[2] Sang Gil Kim, Ja Cheon Yoon, Jong Rae Roh, and Ki Won Ko, "Implementation of Multipoint Multimedia Conference System Using Object Modeling Technique," COMSW98, July 1998, pp81-84.

[3] G. Booch, Object-Oriented Analysis and Design with Applications, Benjamin/ Cummings, 1994.

[4] James Rumbauch, and Michael Blaha, Object-Oriented Modeling And Design. Prentice Hall, 1991.

Creating Poetry For Cyberspace:
A 3-D Haiku Experience

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Abstract: Poetry is no longer limited to the 2-D flatland of a page. With the emergence of VRML, it is possible today to write poetry for cyberspace. This idea was tested by writing four Haiku with the same middle line which were then arranged in 3-D space using VRML so that a cube of poetry was created. The Cosmo Player dashboard tool was used to rotate the cube for Haiku reading. The first and third lines of each Haiku form each poetic cube edge and can also be written to have meaning. Images can be placed as backgrounds behind the poetic matrix, music can be added which can affect the Haiku reading. Other Haiku poetic cubes can also be positioned in the 3-D world to form a "constellation" of Haiku cubes each with different student authorship. Haiku, multimedia and VRML combine for a novel type of interactive poetic experience.

Throughout the ages, poetry has been written to fit the two-dimensional space provided by the area we have come to know as the page. But, with the emergence of VRML (Virtual Reality Modeling Language) and the capability to create interactive, explorable worlds in three dimensions, it is now possible for the first time to write poetry to take advantage of the "extra" third dimension provided by the creation of virtual worlds in cyberspace.

In order to simplify the first exploration of using virtual space as a way of presenting written poetry, the Japanese form of poetry, the Haiku, was chosen as the first type of poetry to be placed in a cyberspace environment. The traditional Haiku is composed of three lines, with the first and last line containing five syllables and a middle line composed of seven syllables. Four Haiku were written with the same middle line so that these four Haiku could all be arranged in three dimensional space around that middle line.

What is produced from this arrangement is a visually appealing poetic matrix that is in the shape of a cube with the center line of the cube shared by all four Haiku. In addition to being able to read the Haiku in their traditional line order, i.e., five syllable line first, seven syllable line second and then a five syllable line, one discovers that when in a poetic cube arrangement, the first and third lines which form the outer edges of the cube, can also be written as poems albeit not Haiku since all the edge lines have only five syllables. This adds another element of complexity in writing Haiku for the three dimensional world because now one must be aware that the "edges" of the completed poetic cube can have meaning and must be taken into account in the initial writing of Haiku for inclusion in a cube of poetry.

VRML scripts were written so that novice or experienced creators of Haiku could place their own work in a virtual world so that they could be accessed via the web with a VRML-smart browser. Cosmo Player 2.1 from Silicon Graphics, Inc. and Netscape Communicator 4.06 were used for this study. Cosmo Player 2.1 has full Java support and can accept the inclusion of other scripting languages such as Javascript for the production of buttons and objects which can respond to mouse clicks for a greater degree of interactivity.

VRML has the built-in capability to write text in a three dimensional space with control of its placement along an X, Y and Z axis. One may also choose a font type, size, style and color. In order to provide some help in determining how Haiku should be read when arranged in a poetic matrix, the first and last line of each Haiku were given a color which would differentiate it from any of the other Haiku in that cube of poetry. The middle line which is being shared by all four Haiku in the cubic arrangement was made to animate in color sequence changing color continuously to cycle through each of the colors assigned to the four Haiku. In this way, it made easier to understand the notion that the first five syllable line colored red in the upper right corner of the cube was written to go with the five syllable line colored red in the lower left corner. As the middle line containing seven syllables cycled through its colors, it became red at one point in its cycle to reinforce the reading of this diagonally arranged Haiku from the upper right of the cube to the lower left corner. The opposite left corner

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contained the first five syllable line of another Haiku and was colored green and was linked to the last line of this Haiku located in the lower right corner of the cube which was green also. Again, the middle line during its color cycling became green at one point indicating that the reading of this Haiku began in the upper left corner and proceeded on the diagonal through the middle line to the last line in the lower right corner. The other two Haiku were arranged in a vertical and horizontal direction both sharing the same middle line but differing in color from each other as well as the two Haiku on the diagonals.

By using the "rotate" tool found on the Cosmo Player dashboard, the cubic arrangement of the four Haiku could be rotated around a central axis to explore how the Haiku are arranged in the 3D space of the VRML world. In a frontal view of the poetic cube, it is difficult to read the poetry because the text for all the Haiku is layered three lines deep along the Z axis. In order to read the individual Haiku, the poetic cube should be rotated and twisted slightly to the right or the left. This creates the proper perspective of three dimensionality and makes it easier to visualize the directionality of each of the four Haiku.

The "rotate" tool also must be employed to read the lines forming the edges of the cube. The Haiku poetic cube has four faces that contain three lines of five syllables each. It is challenging to write four Haiku with the same middle line and this process becomes even more complex when the first and last lines of different Haiku are written to have meaning when arranged together on one of the edges of the cube. The writing and positioning of poetry for 3D display calls upon both right brain and left brain functions as one first captures ideas and thoughts in text and then secondly must work with that text for its ideal arrangement in the very visual world of the 3D environment.

The VRML world may also be designed to have a sky, horizon and landscape in a background which creates some visible landmarks that also move with changed perspective as the Haiku cube is rotated. Images may also be mapped as a texture onto a flat, thin rectangular shape. This rectangle can then be positioned as a wall along the Z axis so that it is now located behind the poetic matrix and is viewed by looking through the Haiku text. The images can be obtained locally from one's own server or hard drive but VRML also provides the option to designate URL's at other sites anywhere on the web as sources for background images or for use as a texture to map onto a flat, thin rectangular shape which can now be observed behind the text as one reads a particular Haiku.

Images can be placed as backgrounds on all six walls of the virtual world in which the Haiku now exist and these images can be chosen to create different meanings from the reading of the Haiku as one observes the image while reading the Haiku. Musical clips may also be activated while reading the Haiku and these clips also can be chosen for their emotional impact while reading the Haiku. In this way, Haiku placed in virtual space can combine with images and sound for an interactive multimedia experience.

The ability to write Haiku and arrange them in a three dimensional array offers a new perspective on the writing of poetry. It may offer students the opportunity to take a greater interest in writing poetry and it challenges the more experienced poet to be a wordsmith as well as a designer of spatial poetics. The three dimensional spaces or worlds offered by VRML can be quite large and there is no reason why many poetic cubes cannot be placed throughout that world. One might imagine many cubes of poetry located both near and far away from the opening viewpoint. When one has many Haiku poetic cubes arranged throughout a virtual world, it is possible to script in VRML a number of viewpoints which can then be selected from the Cosmo Player dashboard for easy travel through the virtual space to that particular Haiku. One might liken this world to a constellation of poetic cubes waiting to be traveled to and explored by the skillful use of the tools provided by the VRML player of your choice. A VRML-based web world can also be created for the placement of poetic cubes constructed from the contributions of many poets. Visitors to this page would be invited to travel as cybernauts from one Haiku island to another.

The web site located at http://users.rowan.edu/~kolitsky may be accessed to demonstrate how Haiku can be placed in a virtual world to form a poetic cube. Also, a world containing many poetic cubes may be visited at this site to further underscore how this method of writing Haiku for cyberspace can be used as a tool to encourage students to write Haiku and place them in cyberspace for viewing anywhere in the real world.

Examination Registration and Course Feedback System for Students in the Intranet

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Abstract. The aim of the study was to develop a WWW based examination registration and course feedback system that covers the whole Tampere University of Technology (TUT), serving students, as well as teachers and other personnel. The examination registration system makes it possible for a student to register himself or herself in any available examination arranged at TUT. While registering the student can also give feedback. The course feedback system includes the generation and analysis of course feedback pages, giving feedback and the creation of a summary. The system has been in test use by students of the Department of Mechanical Engineering (about 900 students) since November 1998. The personnel of the same department has used the system since January 1999.

1. Introduction

The effect of the Internet on all information and communication increases continuously. WWW education has been developed at Tampere University of Technology (TUT) for a few years. Active institutes in this field have been, e.g., Electric Power Engineering, and Hypermedia Laboratory at the Department of Mathematics.

The existing Unix based (non-web) program (OINFO) was the basis for developing the new web system. OINFO is a large system which includes, e.g., registration for courses (about 800) and examinations, as well as a feedback system. The development of a new web system (for Microsoft NT 4.0 environment) was started by creating a new course feedback system that covered first one department (demo version), and then continued to cover the whole university (test version). The examination registration system was being developed at the same time. After a password protection was created (autumn 1998), both systems, examination registration and course feedback system, were linked together. However, for the time being, the old WWW based course feedback system (without password protection) was left in daily use at TUT.

The aim of the study is to develop a WWW based examination registration and course feedback system to serve university students and teachers. The functionality and usability of the system has also been tested. The results are presented in this paper.

2. Description of the system

The examination registration system contains two main parts: an examination registration part for students and an administrative part for personnel. The course feedback system consists of three main parts: generation and analysis of course feedback pages for personnel, entering course feedback for students, and summary of course feedback for everyone. In addition, the system includes a lottery for students, which works as an incentive for giving course feedback.

Each user has a personal user ID and a password for logging into the system. Students and personnel log into the system using different URLs. The system allows navigating only through fixed paths. The user information is in memory until a user logs out. There are different time limits set for using the system. Logging into the system must take place within one minute. The system allows five minutes for staying on each page. If the time is exceeded, the system logs the user out. After the user has logged in the system, she or he can select a different number of examinations from the examination lists of different units of TUT. As the selections have been made, the registration can be done.

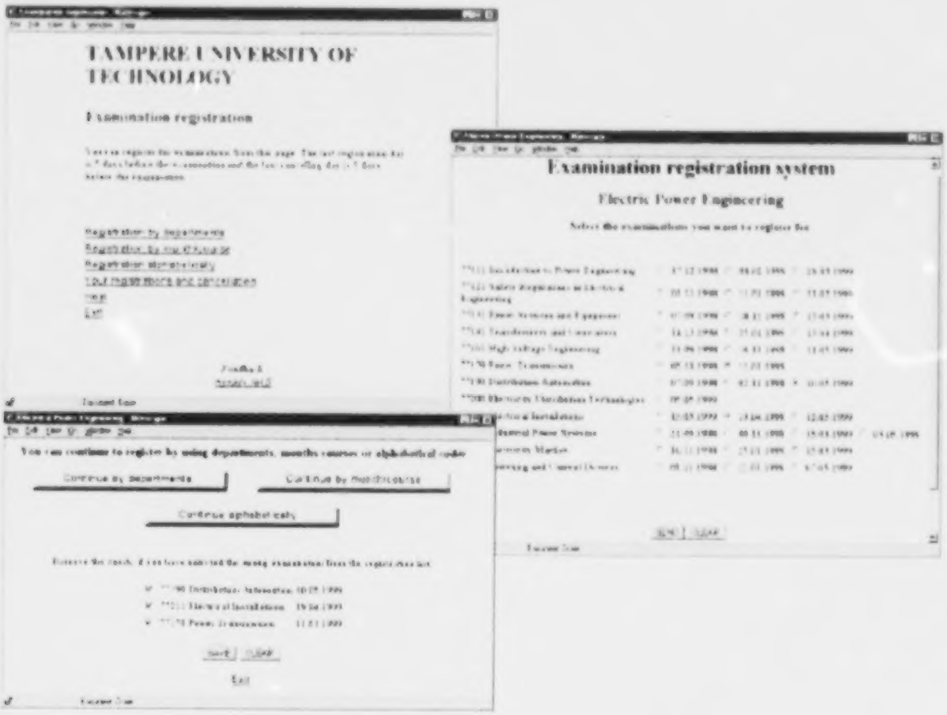
TAMPERE UNIVERSITY OF TECHNOLOGY
Examination registration
Registration by departments
Registration alphabetically
Help
Exit
Examination registration system
Electric Power Engineering
Continue by departments
Continue alphabetically
Exit

Figure 1: Example pages for the selecting examination dates in the registration system

The web system was programmed in Perl 5 language, but plain html based coding was also used. The examination registration system includes 223 Perl scripts and 78 html files, and the course feedback system contains107 Perl scripts and 747 html files. The program runs in different browsers (e.g., in Netscape 3.01 and Internet Explorer 3.0).

3. Testing of the system

In the first phase step, the examination and registration system was tested by the programmers. All links were tested, and calculation results were checked. In August 1999, the system was demonstrated to all departments of TUT. The Department of Mechanical Engineering was selected as a test department. In October 1998, userIDs, passwords and instructions for the system were e-mailed to all students of mechanical engineering. After that the students could register in the system. Training demonstrations for department secretaries were arranged in January 1999. They have began to use the system with other personnel of the Department of Mechanical Engineering. The old UNIX based (non-web) program is used by other departments of TUT.

Generally the system has been working well. The system has not collapsed even once. By the end of January 1999, the administrators of the system have received 49 comments about the system by e-mail. The problems have mainly been related to logging in the system for the first time. Some students have used a wrong password, because they did not read instructions carefully enough. Feedback from the system is received by email. The feedback has mainly been positive. The system is being developed further.

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How the Hypermodern Technology Assemblage Bites Back

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Abstract: Institutions of higher education have been rapidly moving toward ever-more non-traditional methods of producing and distributing knowledge, joining what Wise (1997) called the "hypertechnology assemblage". The terms hypermodern technology (or hypertechnology) refer to "...not just one piece of equipment, but the entire globally interconnected assemblage of new communication, transmission, and information technologies...which share a formal resonance or common episteme" (Wise, p xvi).

1. Introduction

The authors consider a broad range of possible pitfalls that this international assemblage can have for higher education, particularly considering the interposing of technology between teacher and student. If faculty are not careful, they will find themselves short changing their students in the use of "post-it-note" transmissions using voice mail, e-mail, list-serves and [illegible] hypermodern communication methods. The authors have found, for example, that while term papers contain fewer spelling errors, students are not better spellers, and they may be worse spellers than their predecessors, who were non-users.

2.The Problem

Traditional education was characterized by relatively closed classrooms, with instruction contained solely within bounded physical space where it utilized locally available resources. These practices paralleled the larger social and economic organization of the surrounding community. But the post-industrial period has witnessed a transformation of the surrounding organizational field from an industrial to an information-based environment, and educational institutions are rushing to catch up.

The use of one-way and semi-synchronous television instruction has created a host of potential pitfalls for educators. Unlike face-to-face interaction in conventional classrooms where both professor and student shared in the creation and execution of the learning process, hypermodern technology has instead restricted the instructor's knowledge of students to available photographic images or textual representations. Likewise students experience flattened and truncated two dimensional views of their professors. According to Dede (1991) "The teacher faces the challenge of building an intellectually and emotionally attractive telepresence, like that of Bill Cosby, Captain Kangaroo, and Mr. Rogers ...having psychosocial consequences which are not well understood." (Dede, p. 149).

There are numerous problems associated with the current push to acquire and upgrade hypertechnologies. Sassone, (1992), for example, has found that highly trained educational professionals are spending more of their energy engaging hypertechnological activities that amount to secretarial and clerical projects. While Birkerts, (1996), argues that even though computer networks may be seductive places to work, play, and educate, they remove professionals from the ebb and flow of the natural networks found outside the classroom. Textual messages can be sent across a computer net in a few milliseconds, but conversations and other meaningful life experiences, so critical for role modeling, require much longer periods of time to unfold.

Communication oriented hardware and software, so important to distance learning and the electronic campus, promise to link students and faculty together, they actually promote social distanciation through the exchanging of time-staggered messages. Faculty report that hypermodern communication methods are "easier" or "more convenient", but they may also find that personal relationships central to educational communication are being avoided, not encouraged. Such electronic post-it-note communication does not always favorably compare to the all important sharing of streams of consciousness available in face-to-face interaction in traditional higher education, especially in mentoring relationships.

Until better data are available, we hold that technology should be viewed solely as an ancillary tool to support the production and distribution of knowledge, the development of skills, and the examination of the value bases of our profession. We need much better data to assess how students adapt to temporal and spatial distance, how they relate to the emerging physical and spatial aspects of learning off site, how they manage access to sometimes costly equipment, and how they adapt to individual differences in reception of electronic messages. This is especially important when the agents of transmission (electronic devices) were originally designed to mass communicate to essentially passive non-adult audiences.

We are not arguing that technology harms directly, but rather that it is being misused when employed to mediate interpersonal relationships and when it serves to satiate market commodity fetishes without regard to effectiveness. We hold a corresponding view of the dynamic involved in critical learning environment, especially for non-traditional learners. Gadgets and mechanical objects cannot substitute for human pedagogy. Technology bites back, especially in regard to the lost opportunity costs. We offer the following recommendations We need to advocate for low cost or free access to the Internet as a form of public admission to the international assemblage.

3. Summary

We need to be mindful of the impact of hypertechnology on the environment, especially in the Third World. We need to be mindful that hypertechnology often requires the use of language which differs from ordinary everyday vernacular. The use of novel terms and specialized meanings may have the effect of leaving students or clients behind, (Karger & Kreuger 1988). More and more challenging research into the beneficial effects and what may turn out to be unwelcome iatrogenic effects of technology in social work practice and education for practice. We need new paradigms which help us think through as a profession the issue of hypertechnology in terms of it's socioeconomic and political consequences. Core values important to social work and moral issues on human subjects and human rights need to be considered, including the code of ethics. Wholesale application of specific technologies involved in distance learning and the electronic campus and carefully crafted empirical evaluation on outcomes and long term impacts on professional training;

4. References

Birkerts, S. (1996). The electronic hive: Refuse it, in R. Kling, Computerization and controversy: Value conflicts and social choices, (pp. 79-82), San Diego, CA: Academic Press

Dede, C. (1991). Emerging technologies: Impacts on distance learning, The Annals of the American Academy of Political and Social Science, 514, March, 146-158.

Karger H. & Kreuger, L. (1988) Technology and the "not always so human' services, Computers in Human Services 3 (1), 111-126.

Kitchin, R. (1998). Cyberspace: The world in the wires, New York: John Wiley and Sons

Kreuger, L. (1999). Shallow Science?, Research on Social Work Practice, 9(1), 108-110.

Sassone, P. (1992). Survey finds low office productivity linked to staffing imbalances, National Productivity Review, 11 (2), 147-158.

Stretch, J. & Kreuger, L. (1992). New challenges of technology for social work administrators, in L. Healey, Managers choices: Compelling issues in the new decision environment, Washington, D.C.: NASW Publications, 56-64.

Wise, J. (1997). Exploring hypertechnology and social space, Thousand Oaks, CA: Sage Publications

A MODEL FOR WEB-BASED COLLABORATIVE PROJECT - LEARNING LANGUAGES AT WORK

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Abstract
In this paper we will discuss a model for organizational training in the area of languages. The recent technological developments have led us to an illusion that staff development programs are easy and cost-effective to pull through. This is a partly true but it is in no way sufficient to offer employees access to a multitude information and courses. There still is a need for expert guidance in finding the suitable solutions for the individual learner in the maze of possibilities. Largely because learning outside formal schooling differs from the ways in which most adult learners remember on the basis of the own experience from their years in school. We need to expand the old concept of learning to include a dynamic idea of knowledge, shared cognition, collaborative learning and the changing roles of learners and teachers.

We have quite a lot of well-designed technology available and a lot of effort is put to improving the old and developing new technological aids for learning. What is lacking, however, are functional pedagogical models, which would allow those who work in these environments, both the learners and their teachers, to control their learning processes so as to get a feeling of "really learning". By combining aspects from the existing resources - pedagogical and technological - we aim at designing a flexible framework, which would lend itself to versatile uses/users. It is not uncommon that people who have received a considerable amount of formal schooling in languages, for one reason or another fail to use the language in real life situations.

The aim of this approach is to provide a model learning languages at work. This model offers a shared space and built-in guidelines for the learning process. One of the central points is that the contents are not determined externally, but instead they are produced together with the people involved in the process, the employer and the employee. Even though the employer is the funder of the training in most cases, successful learning outcomes cannot be achieved unless the employees themselves are involved in the planning of the learning content, process and goals.

The underlying factors of every individual learner should not be overlooked when planning and carrying out the training. The learners come from very different backgrounds, have varying grades of motivation, different learning goals, different entry levels and also varying amount time and energy to invest. As for the employer, the training has to react to the rapidly changing contents of work, and the diversified groups of trainees (time/lenght, depth).

There are three main building blocks involved:

- Analysis of the participants' language abilities and the language needs in their work
    - using a web-based diagnostic self-assessment tool (DIALANG, http://www.jyu.fi/DIALANG) to set an so called entry-level for the learner

- Planning for the collaborative process (tools for student learning/evaluation)
  - support questions and an transparent and transforming structure
  - various collaborative approaches for producing the learning content
  - various web-based tools (ProjectTools, COW) as the shared meeting place

- Launching the learning process
  - the goal is to support learners' language awareness and autonomy and to offer learning task which offer enough challenge as well as support to the learner

We will briefly describe the previous experiences of the reseach group on which the current model builds on. These include projects in which focus has been on improved interaction in web-based learning environments and also staff development programs where technology has been incorporated into the process of doing learning.

References

Collins, A., Brown, J.S. & Newman, S.E:. (1989). Cognitive apprenticeship: teaching the crafts of reading, writing and mathematics. In: Resnick (Ed.), *Knowing, learning, and instruction: essays in honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Lawrence Erlbaum Associates.

Fairclough, N. (1989) *Language and Power*. London, Longman.

Goodwin, C. & Goodwin, M. H. (1992) Assessments and the Construction of Context. Duranti, A. & Goodwin, C. (eds) *Rethinking Context. Language as an Interactive Phenomenon*. Cambridge, CUP, 147 - 189.

Kuure, L., Saarenkunnas, M. & Taalas, P. (1999). Negotiating a New Culture of Doing Learning. Paper presented at CAL99 conference, London, 29-31 March 1999.

Lave, J. & Wenger, E. (1991). *Situated Learning. Legitimate Peripheral Participation*. Cambridge. CUP.

Maybin, J. 1996. Everday Talk. In Maybin, J. & N. Mercer (eds*) Using English From Conversation to Canon*. London, Routledge & The Open University, 5 – 41.

Morrison, D. & Collins, A. 1996. Epistemic Fluency and Constructivist Learning Environments. In Wilson, B.G. (ed.), 107 – 119.

Nunan, D. & Lamb C. (1996). The Self-Directed Teacher. Managing the Learning Process. Cambridge. CUP.

Resnick, L. B., Levine, J. M. & Teasley, S. D. (Eds.) (1991). *Perspectives on socially shared cognition*. Washington, DC: American Psychological Association.

Saarenkunnas, M., Järvelä, S., Häkkinen, P., Kuure, L., Taalas, P., & E. Kunelius. (1999). *NINTER - Networked interaction: theory-based cases in teaching and learning*. Submitted manuscript.

Salomon, G. (1993). *Distributed cognitions. Psychological and educational considerations*. CUP. Cambridge.

Sarangi, S. 1999. Identity Work in Professional Discourse Studies: The Dynamics of Interactional and Institutional Orders. Lecture given in the 19th Jyväskylä School of Applied Language Studies. University of Jyväskylä, 8th June, 1999.

A Web Based Authoring And An Adaptive Tutoring System For teaching And Learning

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ABSTRACT

In this paper we describe the approach to merge a hypermedia authoring system (MEDIT) with an adaptive tutoring system (CAMELEON), in order to build a complete teaching and learning environment on the WWW. The aim is to support the use of the WWW in education such as a cognitive tool, for the improvement of learning effectiveness.

KEYWORDS: Web Based Training, Hypermedia Authoring System, Adaptive Hypermedia

INTRODUCTION

Every distance education system addresses both actors concerned, teachers and students, offering them the corresponding working environment: an authoring system and a tutoring system. However, as far as we know, no existing research projects deeply investigate both aspects. In an educational hypermedia environment we often take care of the student which is the final user. The vast majority of existing systems adapt their interface to the student using information represented in a user model [3], such as knowledge level, gender, age, background etc. Nevertheless authoring systems are also an important part of the whole environment allowing teachers to introduce and manage the course content without dealing with technological drawbacks. For this reason we believe that offering a tailored hypermedia authoring system for teachers, coupled with an adaptive tutoring system for students could be the best way to assure an increased effectiveness. That's why we merge MEDIT (Multimedia Environment for Distributed Interactive Teaching) with CAMELEON (Computer Aided Medium for LEarning On Networks), to give a complete teaching and learning web based environment, who inherits the advantages of each system and throws out the hindrances of each isolated one. In the first two parts of this paper we describe in more details both MEDIT and CAMELEON, in the third part we illustrate how we build a complete environment from the two systems.

MEDIT

MEDIT [2] (Multimedia Environment for Distributed Interactive Teaching) is Web Based Teaching environment for the creation, management and delivering of a university course on the Web. The main goal of MEDIT was to build Hypermedia Authoring Systems suitable for WBT, allowing users to manage the whole course components without facing with technical problems. Unlike other WBT authoring systems, MEDIT management of the course content is suitable for different level of HTML knowledge. Moreover MEDIT has been conceived to increase the pedagogical effectiveness of teaching in order to use the WWW such a cognitive tool to support problem solving, collaboration, coaching and authentic tasks. In fact the environment supports all teaching and learning processes experienced by the students and carried on during the educational activity [4]. All these process components are grouped in MEDIT in three main activities corresponding to three working spaces: Course, Exercise and Discussion.

CAMELEON

CAMELEON is the English acronym of Computer Adaptive Medium for LEarning On Networks. It is a system running across the Internet/Intranet, allowing student to access the course content via an adaptive interface.
CAMELEON offers adaptive systems that can compare the student's model and the domain model and thus automatically change its teaching style [7].
Most of the approaches dealing with student modeling involve a rather simplistic model of the learning process and don't take into account of the wide range of learning styles and capabilities. Moreover, neither the student nor the teacher can infer with the student model to adapt it to specific learning styles.
The CAMELEON student model is mainly based on the learning style model proposed by Felder. This model is a fine-grained model for deciding which type of media to display (Text, Images, Simulation, etc.) and works as a coarse grain model to reflect whether the student has or has not mastered the course material presented. The model keeps records of a tutoring session and uses this information to update the teaching strategy for the particular need of the student. All this information can be used as a feedback from learners while they work to master a subject they acquire or improve knowledge and skills. This can be mapped into the student model.

MERGING THE AUTHORING AND THE TUTORING SYSTEMS

MEDIT environment is based on a the conception of working spaces according to the needs of traditional course components: Course, Exercises, Discussion; each of them is then further divided into sub spaces and includes the proper authoring services. Each service realized is a Hypermedia Authoring System, based on structured document approach and on documents reuse features [1].
In MEDIT we developed authoring systems with the goal to take care of pedagogical issues. For this purpose we exploited the possibility for students to personalize documents within a course depending on specific learning styles [6], [5] giving them a Private Working Space. In this space, students can create their own course on the basis of the elements (texts, images, formulas, etc.) of the course content, proposed by the teacher in the Course space. These elements can be selected and automatically copied in the student space. The shared goal of the collaboration is to use MEDIT as an authoring tool for teachers, and CAMELEON as a tutoring tool for learners in order to build a complete and effective educational environment. Teachers will use the authoring environment to introduce the course content (course, exercises, discussions, etc.) including different media such as text, audio, video, simulation, graphics, charts, etc. When the student access the learning environment organized in working spaces, CAMELEON tutoring system intervenes on the display of Course material to present the content in an

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adaptive mode. From the data base of the system is able to generate the adaptive interface for the web course using requests according to the user's model (profile, knowledge level an learning strategy). The student will use the Private Space authoring system, to build his/her own course view. This information will also be used as a parameter to update the learner's model. The Discussion and Exercise spaces are not presented adaptively because in our opinion students have to be trained and acquainted with every kind of tests and exams during theirs study's life.

FUTURE WORKS AND CONCLUSION

In this paper we described the integration of the projects MEDIT and CAMELEON in order to build a complete adaptive and effective learning and teaching environment on the WWW. Our first goal is to create and test a prototype on case study courses in Tunisia and in Switzerland in order to carry on a formative evaluation and improve the system. Future development of the collaboration include the customized management of the physical aspects of the interface (backgrounds, fonts, size, colors etc). It also includes the creation of game space allowing teachers introducing educative games and helping learners to resolve those exercises.

REFERENCES

1. Abou Khaled O. et Vanoirbeek C. Un systeme auteur pour la creation d'applications pedagogique sur le web. Rapport interne 249, EPFL, November 1997.

2. Abou Khaled O., Karacapilidis N.I., Rekik Y.A. and Vanoirbeek C. Medit: A web-based environment for advanced pedagogical issues. In Proceedings of the 4th International Conference on Computer-Aided Learning and Instruction in Science and Engineering CALISCE'98, pp. 325-333, June 1998.

3. Brusilovsky P. Methods and techniques of adaptive hypermedia. User modeling and user-Adapted Interaction Journal (UMUAI), 6 : 87-129, 1996.

4. Collis B. Pedagogical reengineering: A pedagogical approach to course enrichment and redesign with the www. Educational Technology review, Autumn/Winter 1997.

5. Daniels H.L. Interaction of cognitive style and learner control of presentation mode in a hypermedia environment. Mémoire de D.E.A., Virginia Polytechnic Institute, July 1996.

6. Felder R.M. Matters of style. volume 6(4), pp. 18-23,Prism, December 1996. ASEE.

7. Laroussi M. Ben Ahmed M. Providing an adaptive learning through the web case of cameleon: Computer aided medium for learning on networks. In Proceedings of the 4th International Conference on Computer-Aided Learning and Instruction in Science and Engineering CALISCE'98, June 1998.

Comparison of Computer Science and Humanities Student Preferences Concerning Web-Based Supplemental Course Materials

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Abstract: What sorts of Web-based course supplements would students find to be most useful and least useful? Is there a difference in what students in computer science courses would prefer and what students in a humanities course would prefer? Answers to these questions were sought by surveying students in both computer science and philosophy courses. Briefly, we found that there was a core of materials that both groups of students would find helpful. There was also a high degree of agreement concerning what they would find least helpful. Finally, there were some interesting differences on some of the items between computer science students and philosophy students.

This paper presents a study that was done on the use of Web-based course supplements in an otherwise traditional classroom college course. Most of the articles on Web-based instruction discuss such matters as the design of Web pages and the correlation of Web-based materials with instructional objectives. The problem is that the majority of these discussions are based on the operating assumption: "If you build it they will come." However, our study suggests that the safest assumption to work with in providing Web-based instructional materials is: "If you build it they will come–maybe." This assumption raises a number of questions. Do students think that Web-based course supplements would be useful? Or is the work involved in creating them wasted effort? What sorts of supplements would they find most useful and least useful? Is there a difference in what students in computer science courses would prefer and what students in a humanities course would prefer? Do male and female students have different preferences on this issue?

Answers to these questions were sought by surveying students in both computer science and philosophy courses. The responses of approximately 120 students in computer science classes were compared with roughly the same number in philosophy classes. The philosophy classes were several sections of introduction to philosophy. However, to balance the number of responses, the computer science surveys included both entry-level programming sections as well as several smaller advanced classes. The survey was composed of 17 items gathered from a review of materials that are commonly posted on the Web for a wide-range of courses. There were five responses available ranging from "very useful" to "would not use." The two positive responses and two negative responses were separated by a fifth alternative labeled "neutral."

Briefly, we found that there was a core of materials that both groups of students would find helpful. There was also a high degree of agreement concerning what they would find least helpful. Finally, there were some interesting differences on some of the items between computer science students (hereafter, designated as CS) and philosophy students (hereafter, designated as P). The survey that was used, as well as an item by item tally of percentages for each response separated according to the two types of courses are posted at the following URL: http://www.cs.olemiss.edu/webnet/surveyin.html.

The ranking and comparisons of the various items were carried out by combining the two positive responses of "very useful" and "somewhat useful" into one, combined score. The percentages listed below reflect this combined, positive score for each item. For both sets of students, several items received an equal number of percentage points. Consequently, the 17 survey items fell into 14 levels of preference in both cases. Those that ranked 1 or close to it were the most preferred items and those that were closer to 14 were perceived as the least useful.

The items that received the most positive responses (they ranked within the top five) for both CS and P were: (1) syllabus, (2) study questions, and (3) announcements, reminders, and calendar of events. The items that were equally ranked least useful by both sets of students were "on-line chat spaces" and "suggested reading list." Both sets of students also ranked "anonymous feedback to instructor as the course progresses" as fifth from the bottom. It is likely that these items were perceived to have the least direct impact on one's ability to master the material and get a good grade.

There were also a number of interesting differences between the responses of the two groups of students. CS ranked "homework assignments" 2 (91%), but P ranked it 9 (76%). One can only conjecture as to the reasons for this difference. Because philosophy assignments tend to be essays, there are fewer of them. Furthermore, they tend to take the form of a single, simple question or topic. On the other hand, there tend to be more CS assignments and programs to write and the technical details tend to be more complex. These differences may be why CS would like to keep track of the assignments on-line. For P, "lecture notes" received the second highest score (91%), but ranked 8 for CS (81%). This may be because philosophy lectures are harder to follow or it may be because CS instructors tend to use more outlines and handouts when lecturing.

CS ranked "interactive exercises" 6 (85%), but P ranked it third from the bottom at 12 (61%). Perhaps, this is because there are more possibilities for helpful CS interactive exercises. The philosophy students may have perceived that it would be hard to design interactive exercises in philosophy that would help them master the conceptual material. In philosophy logic classes, however, there are a number of interactive tutorials available. Although this was not studied, it would be reasonable to expect that "interactive exercises" would have gotten a higher ranking in logic classes.

The item "links to web sites relevant to the class" ranked 6 (85%) for CS, but ranked 11 (70%) for P. While the majority of P thought it would be helpful, CS may be more practiced in seeking resources on the Web than humanities students and, therefore, ranked it higher.

Interestingly, concerning the item labeled "class members e-mail addresses and links to their web pages," P ranked it 8 (77%), while CS ranked it lower at 12 (66%). Any proposed reason for this difference would only be speculative. Perhaps this form of communication is rather routine for CS students, so they took it for granted. On the other hand, this may be more of a novelty and an exciting idea for humanities students. However, this seems to be inconsistent with the fact that P ranked "chat spaces" the lowest. One would think that in a philosophy course, they would welcome the opportunity to continue the class debates in this way.

Since there did not seem to be any significant differences between the responses of males and females, these statistics have not been included in this report. Likewise, categorizing the responses by age or year in school (freshman to graduate student) did not seem to yield any interesting results. Initially, it was hypothesized that females would be more oriented toward collaborative endeavors and sharing opportunities. However, the male and female responses (the percentages of both the positive and negative responses) on the e-mail and chat space items seemed to be about the same. Even if female students tend to be more oriented toward collaborative group experiences (as psychological studies suggest), they may also be more reluctant to communicate with fellow students who are more or less strangers. Also, the female students (and males as well) may have perceived that this faceless, detached, distant form of electronic communication was not one that would enhance their class experience. It was also hypothesized that CS would consistently rank most of the items very high, while P would be less enthusiastic about Web-based instructional materials. However, while they did register some differences in preferences, the P group seemed to be equally enthusiastic as the CS group about on-line, instructional resources.

In conclusion, both computer science and humanities students believe they would benefit from Web-based course materials. However, which ones should be used will vary with the nature of the class. Furthermore, it was found that it is difficult to anticipate what students will find helpful. Surveys of this sort, both at the beginning of the semester and at the end, will be helpful in discovering what students initially perceive they will need and, after more experience, what they have actually found to be helpful. A further study that would be revealing would be to incorporate some of the items that received the lowest scores into a course. Then one could see whether or not the students ranked them higher at the end of the course once they have had experience with using them. This is particularly true since many of the students surveyed had not had the opportunity to try out some of these items (such as on-line chat sessions) and therefore were simply going by how useful they imagined or guessed these items might be. These sorts of considerations will guarantee that if you build it, they will indeed come.

New Technology In Information And Communication : A French Experience

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ABSTRACT: The article presents an experience in the domain of New Technologies of Information and Communication. The training strategy adapted gives a great importance to the realisation of computer multimedia applications by students. This is done in co-operation with companies and this five year activity yielded three main extensions. The setting of an apprenticeship organisation which enables the student to work inside companies with the methodological support of university staff. The setting of distance learning activities contribute to life long training. The synergy between those actions provides an example which may be extended to other sections.

1 Introduction

One of the changes induced by the information society which is constituting itself before our eyes regards is the fact that sources of knowledge are more and more diversified. This affects the traditional function of transmission held by universities [Berger, Levraux,96]. In our opinion, a way to face it is to use new technologies of information and communication for knowledge transmission, as much as possible and to put much human contact and efforts to help students acquire know-how. Of course, know-how are related to precise activities, and this brings up right away the problem of relations between companies and universities. The following article is a synthesis of experiences on these topics held by the author.

The first input is related to the effect of this evolution to the teaching strategies in the context of a course : the DESS SIM (Multimedia Information System) is a one year postgraduate training to multimedia. This course is intended to form future professionals, and devote a lot of time to the development of computer or multimedia projects. Most often, these projects lead on to an effective realisation of products or make ups of real applications. They always imply three partners : the student, a company, or an end user and a member of the university staff. This latter plays the part of project manager. In this part he puts an accent on methodology training, behavioural training, and has also a part as of mediator between the cultures of university and companies. This role led quite naturally to put accent to methodologies and more specifically to those needed to drive multimedia projects. An other axis of development is the organisation of distance training: it enables to link the training capabilities of the University with a lifelong learning demand [Levraux, 96].

2 A privileged environment

2.1 The practice of alternation between company and university

Dess SIM is a post graduate diploma which provides a 800 hours specialised course in multimedia to people having an initial competency in computer technology. The program aims at making students able to design and realise multimedia applications for business: communication, advertising, co-operative activities, training, etc... The main competencies addressed are ability to analyse a system of information and communication, knowledge of multimedia applications and development systems, mastery of sound and video processing, ability to structure and manage multimedia information. Practical projects consist on the design and realisation of a multimedia mock up.

In this course, the organisation of the training is divided in formal teaching and practical projects development. Projects are very important: they takes about 50 % of the time and is equally important at the examination. It is a way of learning by doing information technology and multimedia. Students, University staff and external experts meet together for these projects.

The development of apprenticeship in higher education registers itself in the continuity of state laws which have made the apprenticeship juridical bounds more flexible in order to favour men extension to new professions and to higher qualification levels. It thus seemed important to lead this action within the DESS SIM through the development by each student, alternatively, of professional projects. The apprentices are entrusted, within the scope of the prepared professions, to professional activities where the progression is organised by the companies after a dialogue with the university. This activity in the firm, accompanies at the best the progression of the education, and favours an alternating pedagogy.

2.2 A distance education platform

A distance learning action, related to the DESS SIM, has been launched at the University with support of the French Ministry of Education, Regional. In order to put into place the distant training plan, various stages have been considered:

1. At first, the writing of a book: "*Technical basis for the multimedia*" [Weidenfeld, Leclet, 97] have been made as paper class support.
2. Secondly, the making of hypermedia books has been taken into consideration. This work of bringing into hypermedia form this book is nearly finish. Compared to the paper version, this hypermedia have two major plus: ***indexing*** (a pre-eminent work about the contents allows to constitute an index organised according to a predefined frame : "biographies", "technical aspects", "methodological aspects", "professional activity", ..., [Bayrou, 97]) ; ***a complementary browsing method*** is provided by an additional "linguistic" work on the index. A collaborative definition of synonymies, antinomies, proximity's, etc enables to build a thesaurus. This thesaurus enables, in return, to create links quite automatically [Fauroux, 96].
3. At last, the use of interactive simulations for some of the previous activities. It is possible to associate an interaction, achieved through a computerised program, to the part of the hypermedia which will illustrate the illustrated notion. We shall call such a program an *interactive simulation*.

An initial interview (with the possible help of a screening system) allows the elaboration for each person of an individual degree course. This elaboration takes into account the acquisitions and the objectives of each one. In the end, it comes to the global suggestion of modules and/or to the suggestion of supports to be studied, as well as an evolution within this study.

Moreover, for each of the modules, there will be an allocation of individual tutoring during two hours. This tutoring allows the correction of the applications and activities offered in this module and the settlement of a regular communication, through e-mail, between the tutor and the learner. This e-mail (with *mail* and *talk* facilities relies upon the installation of a server accessible from the university servers). Besides the individualised help given to the learners, this e-mail will make the updating of so-constituted knowledge, easier. Therefore, the messages exchange format will include such elements as: the information, by the learner, about the reference of the chapter(s) regarding his question or the information, by the tutor, of the general interest "level" of his answer (circumstances or deepening compared to the existing contents).

3 Conclusion

This various activities developed are in the scope of the future university model. The alternating organisation enables to develop a rich partnership between the University and companies. One of the key factors to the success of this partnership is the visibility of the training paths. The evolution of New Technologies of Information and Communication leads quite naturally to open and distance learning organisations. It is one of the devices, which enables long life training.

References

Bayrou J.F (1997) *Rapport " Education-Entreprises - 20 ans de partenariat"*, MERS, Paris.

Fauroux M. (1996) "*Rapport sur l'Education*", Rapport de la comission Fauroux, Paris.

Leclet D. (1995) "*Le rôle des objets dans une formation multimédia*", IAE, Paris.

Levraux B. (1996) *Rapport "Les états généraux de l'Université"*, livret etats géneraux, MERS, Paris 96.

Weidenfeld G. & al (1997) "*Techniques pour le multimedia*", Ed Masson, Paris 97.

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Web-based Instruction: A Study of the Effects of Self-Efficacy and Task Values on Students' Commitment and Achievement

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Abstract: This study explored whether students' task value and self-efficacy would enhance their commitment and achievement in a WBI class in Taiwan. This study compared students' commitment, achievement, self-efficacy, and task value with and without a training workshop that was designed to increase students' commitment and achievement. The results of this study included: (a) the higher task value students' perceived, the stronger commitment they made; (b) The higher self-efficacy students held, the easier the task was perceived; (c) The training workshop had positive impacts on students' perceived self-efficacy, interest, and importance.

Introduction

Web-based instruction (WBI) class pages have been used not only in fully distance programs but also in supporting the face-to-face traditional classroom for the purpose of increasing class interactions. Researchers, such as Jonassen (1995), have suggested that the use of WBI class pages can create an effective learning environment by creating asynchronous communications, collaborative learning, and case-based instruction. It is expected that students can self-motivate and can perform higher order thinking by actively participating in meaningful discussion with their peers. The self-pacing benefit of asynchronous learning on the WBI class page becomes a disadvantage when learners are unwilling or unable to be self-motivating or self-regulating. When learners lack required skills or task value they may not adequately direct their own learning. Learners who have lower self-efficacy tend to achieve less successfully than those who have higher self-efficacy (Bandura, 1997). Those with higher task value tend to devote more effort in the use of learning strategies resulting in better performance. Task value has indirect impact on Taiwanese students academic achievement through influencing effort (Wang, 1997).

The Problem and Study Purpose

In most Taiwanese classrooms, students are passive and quite listeners and they record class notes and memorize factual information. It is rare to see meaningful discussion between teachers and students (Tyan, 1998). In Spring 1998, a professor at National Taipei Teachers' College adopted WBI to support classroom instruction. Case studies were used as the major instruction method with 4-6 open-ended questions posted for each case on the WBI class page. Students were required to post their responses as essays, read others responses, and provide feedback to others. The goal of the class was to increase student interactions, and to construct meaningful discussions through collaborative learning. At the beginning of the semester, students showed a very high interest in online discussions. However, by the end of the semester, the number of responses decreased. The goal of commitment of increasing discussion interactions decreased. After interviewing the professor and the students, it was noted that since this was a new learning approach, students did not recognize the task value of cased-based discussions. Most of students were not confident with this new learning approach. Student self-efficacy in conducting a meaningful discussion was low.

Methodology

Thirty students at a teacher education institution who were enrolled in a WBI class in educational technology were randomly assigned to a treatment and control group. None of them had experience in performing online cased-based discussions. The research design for the study consisted of: (1) Control-treatment comparison of subjects' achievement, level of self-efficacy, task value, and commitment; (2) Investigation of the correlation relationship among subjects' self-efficacy, task value, commitment, and achievement; (3) Interviews and observations of subjects. A pre-intervention survey was distributed at the beginning of the semester and a six-hour workshop was presented before conducting the first case study for the treatment group. The objectives of this workshop were to (1) increase students' positive task value and (2) increase their self-efficacy by teaching them necessary strategies with practice for improving their performance. Two useful job aids were presented for helping students assess their commitment problem and for improving their performance on case studies. This workshop included a considerable amount of student interaction, practice, and in-class discussion. An evaluation survey was distributed immediately after the workshop. In the following three weeks, students posted their responses with an essay format in answering open-ended questions for case one. At the end of this period, a post-intervention survey was distributed and a grading rubric utilized to measure students' achievement in case one. The study compared subjects on scores of the first case study, their perceived self-efficacy, task values, and numbers of posted responses, and investigated the relationship among students' task values, self-efficacy, students' numbers of online responses (refer as commitment), and scores of the case study (refer as achievement).

Results and Conclusions

The results from the study revealed students' task value had significant correlation on their commitment in a WBI class. The higher self-efficacy students held, the easier the task was perceived. In addition, teaching students necessary learning strategies and providing them more practice would increase their self-efficacy. This finding supported the previous research, such as Bandura (1997), that individual's level of self-efficacy is not stable and can also be affected by many factors such as providing necessary training to improve skills or knowledge and giving them more practices so that these positive learning experiences will become another entry characteristic to increase self-efficacy. This study found that emphasizing the importance of the task and connecting it to students' personal relevance would increase students' task value. This finding also supported the previous research studies, such as Schiefele (1991), that discovering the task's features by relating its importance or personal relevance stimulates students' task value. However, the self-efficacy did not demonstrate its effects on students' commitment and achievement. Four implications of the study include the following. 1) Teaching students necessary learning strategies and providing them more practices may increase their self-efficacy. 2) Emphasizing the importance of the task and making it relevant to students may increase students' task value. 3) Considering the effect of students' task values on their commitment should be a part of WBI course planning. 4) Training workshop can be one example for instructors who try to increase students' task values and self-efficacy in WBI.

References

Bandura A. (1997). Self-efficacy: *The exercise of control.* New York: W.H.Freeman and Company.

Jonassen, D.H., Davidson, M., Dollins, M., Campbell, J. & Haag, B.B.(1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education*, 9, (2), 7-26.

Schiefele, U. (1991). Interest, learning, and motivation. Educational Psychology, 26 (3&4), 299-323.

Tyan, N.N. (1998). *When western technology meets oriental culture: use of computer-mediated communication in a higher education classroom.* A paper presented at annual conference of the Association for Educational Communications and Technology, St. Louis, Missouri.

Wang, S. (1997) *The roles of perceived beliefs in effort, self-efficacy, and task value on high school students' effort and math achievement in Taiwan.* Unpublished dissertation. Los Angeles: University of Southern California.

Interactive Images: Explorations with OpenPix

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Abstract. This paper addresses the problem of image transmission over the Internet. Work-in-progress with an IIP-compliant image delivery and management platform, Hewlett Packard's OpenPix Image Igniter, in an art education context is discussed.

1. Introduction

This work_in_progress addresses the problem of image transmission over the Internet. High quality image files are slow to download over the Internet. Rather than wait for such images to arrive, users will drop a connection and move to another site. This problem has inhibited the development of image intensive WWW based applications and restricted the quality of the work displayed in on-line museums and art galleries. To resolve such problems, a multi-purpose, information rich image format is required which would provide bandwidth efficient web viewing by allowing an image to be downloaded over the Internet at a resolution appropriate to a user's purpose and device capability. Two Internet imaging open industry-standards have emerged to meet this requirement: the Internet Imaging Protocol (IIP) and the FPX file format. In this paper we report our work with an IIP-compliant image delivery and management platform, H.P.'s OpenPix Image Igniter.

2. Technical Background

The IIP is an image-transport protocol that provides a standard method for sending "tiled" images and other related information over networks. It is designed to work within HTTP or under a dedicated socket connection. The FPX file format is a tiled-image file format that can support multiple versions of the same image at different resolutions. Each FPX file format image consists of several resolutions of tiled image data, represented in independent 64 x 64 pixel tiles. For example, a 640 x 640 pixel image would consist of 100 tiles. Each resolution is four times that of the previous one. The entire resolution pyramid is stored on the image server, making the overall size of a FPX file format 33% larger than a comparable flat JPEG file. The gain is in efficiency of use of network resources and in download time. When a user zooms-in on an image, only a small portion of the complete file - the tile set defining that part of the image the user wishes to magnify at the next higher resolution - is transmitted over the network. Further, all image transformations are applied by the server before image transmission. This obviates the need for a sophisticated client application in order to view an information rich image. Users can also preview images at a low resolution before requesting the appropriate data for high-resolution printing. Unnecessary network traffic is thus reduced. Only the tile sets and metadata (stored textual information associated with the image such as image description, keywords, author) required to meet a particular need are transmitted over the network. Access to images can also be restricted as IIP provides image security at the tile level. Finally, consistency in the colour of images when delivered to different applications/ systems is ensured through the FPX file format's support of sRGB (http://www.color.org/).

The OpenPix Image Igniter software suite consists of three core components: - a IIP-compliant image server which runs as a CGI, FASTCGI, NSAPI or ISAPI program within a standard WWW server; a set of four OpenPix viewers - a Java applet, an ActiveX component, a Netscape plug-in or a flat JPEG image delivery - and an OpenPix Authoring environment which allows developers to integrate OpenPix authoring extensions within a standard Web page. ImageIgniter permits access to FPX file format, JPEG and uncompressed RGB files. Multi-resolution tiled support for the latter two file formats is provided through the OpenPix Transcoder API which performs tile extraction, scaling and compression on the fly in response to a Web client request.

3. Educational application of the technology

Our primary purpose in using the technology is to enhance the presentation of the Pre-Raphaelite section of the newly designed National Museums and Galleries of Merseyside WWW Site (http://www.nmgm.org.uk/). Fig

1 shows an example of our work. On the left of Fig 1 is a conventional WWW page with the OpenPix enabled image presented inline. When this image is clicked, an OpenPix viewer appropriate to the platform -in this example a Java applet - is automatically downloaded complete with controls which permit the user to select area of the image for exploration in detail, zoom in and out, pan etc. This is illustrated on the right-hand side of Fig 1.

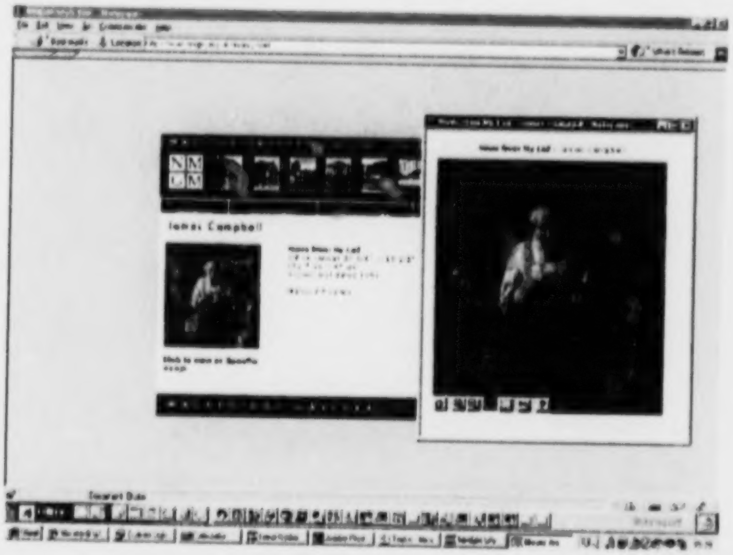

Figure 1: A OpenPix ignited painting

The user is able to actively explore a painting without incurring the high overheads of a complete download of the image on first exposure to it. Museum management can monitor access to and interest in the pictures through the OpenPix ImageReporter facility. The latter permits the construction of visual histograms indicating which pictures and parts thereof in a collection are most frequently accessed. Non-image data such as textual and audio information can be embedded in the FPX file format. In the above example, the only associated 'metadata' is the painting caption and the painter's name. It would, however, be possible to embed more didactic content if, for example, the technology was being used as part of an art history tutorial and music, characteristic of the period, could be embedded. The technology also has the potential to support novel forms of art exhibitions in both an Internet and Intranet contexts. For example, within an Art Gallery one could display OpenPix enabled digital images of exhibits in a flat panel format ideally with a touch screen interface. Children and adults alike could actively explore these images without damage to the paintings either prior or subsequent to viewing these images conventionally. Likewise one could image 'preview area' for an especially popular exhibition that allowed users to interact with the digital images of paintings prior to gaining access to the latter. Coffee tables with embedded flat panel displays of the digital images could be constructed. There are also many other contexts in which the ability to readily refine the detail with which an image is presented is important. Hewlett Packard has emphasised application of the technology in Electronic Commerce - to enhance the display capabilities of on-line catalogues (http://www.image.hp.com/). The higher the quality of the photographic image displayed in an on-line catalogue, the greater the probability that the image can convey features of an object such as its tactile quality and the more opportunity the user has to explore features of a garment - such as logo design - in detail. Telemedicine and geographic exploration are other obvious application areas.

The main issues arising from the deployment of the technology are :- the adequacy of the proposed technical solution to the delays associated with image transmission over the Internet; the support provided for non-programmers in use of the technology, particularly within the authoring environment, and users' reactions to the technology. Other solutions to the problem of image transmission are considered e.g. the Zoom project at the University of Berkeley (http://now.cs.berkeley.edu/Td/zoom.html) and the Viseum project at the University of Southampton (http://www.ecs.soton.ac.uk/~km/projs/viseum/). Both of these also employ tiled image formats. The Zoom project utilises the GridPix format. Because it is based on server scripts the implementation is entirely in HTML and can be supported by any graphical WWW browser without need of a special viewer.

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Web Based Instruction:
Intellectual Property, Compensation, and Redefining Faculty Work

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Abstract: The rapid rise in popularity of web based learning materials has accelerated discussion and debate on the changing roles of faculty in institutions of higher learning. The accessibility of the world wide web and the relative ease with which one can create materials for distribution and facilitate communications for learning have challenged the traditional relationship between faculty and institutional employer. What was once assumed as a normal part of a faculty member's contractual activities can no longer be take for granted. This paper examines two high profile issues in redefining those expectations of faculty work relative to web based instruction; intellectual property and compensation.

Introduction

It is becoming increasingly clear that the sanctity of the college classroom and the dynamic nature of college teaching has been challenged by the creation of semi-permanent collections of mediated materials designed to replace at least some of the need for the physical presence of the instructor. The challenge comes in the form of defining reasonable expectations and conditions for faculty work and productivity.

Complicating the development of strategies to address these issues is the fact that current intellectual property and compensation policies at institutions of higher learning vary depending on type of institution, orientation toward research productivity, geographic location, source of funding, mission, and tradition. In addition to the variability between institutions of higher learning; there are other units that compete with traditional college and university programs including divisions of external education, for profit training and education companies, individual courseware creators, and corporate training divisions which can compete for the instructional talent of able faculty. It is reasonable to assert that faculty personnel policies will have to be aggressively competitive, but institutions of higher learning are struggling with the implications of new compensation policies appropriate to web base instruction because of the implications for traditional faculty .

Intellectual Property

Traditionally, most institutions of higher learning recognized that work directly attributable to the personal creative and intellectual effort of faculty belonged to faculty alone, unless the creative effort was the result of a project sponsored by the university or other sponsor. In the latter case, ownership might reside strictly with the sponsor or be jointly owned by the sponsor and the creator. There are, of course, many shades of gray in determining what constitutes personal effort and what constitutes sponsorship, but institutions have tended to favor the individual.

As mediated learning products gain market value, institutions have been reexamining policies that control intellectual products. Mediated learning materials such as web based course materials have generated much debate and concern on the part of faculty and institutional administrators precisely because of their market value and the investment required to create these materials. The central issue is one of control.

In the case of web based materials, neither the institution nor the faculty developer can wisely be left in total control of these products. New web based materials cannot be developed quickly enough to replace a course which a faculty developer refuses to offer at the last minute. Similarly, a faculty developer's professional reputation is at risk if a course is offered after its accuracy has expired or if it is managed by unqualified personnel simply to improve the economic return to the institution. Additional issues are raised if the institution wishes to sell or lease the materials to another institutional client or if the faculty developer wants to transport the materials to a different institution.

The only reasonable solution to these potential problems is clear ownership policies and special circumstance negotiations. An agreement can be reached through a standard contract that provides a range of options for the faculty developer and the institution. For example, a faculty developer may request a lump sum payment for course materials upon delivery and release all rights to the product, or the institution may offer a percentage of the return on all future use of the materials with little or no initial payment. The variations on these themes are many.

There are ample precedents for this type of negotiation in other industries, especially entertainment. The assumption is that ownership rights of intellectual and creative products belong to the creator, however, these rights can be limited by special conditions or compensation agreements.

Faculty Compensation

Compensating faculty is and will continue to be a complex problem. There is no question that on a course to course comparison with the same number and same quality of students, a course formatted for web based delivery typically requires more time, thought, creativity, and effort on the part of faculty than a similar classroom based course. Issues of equity, measurement, quality, cost and revenue all come into play.

There appear to be three basic institutional responses to the question of how to appropriately compensate faculty for distance learning responsibilities. One model is to offer distance education through a division or school of continuing studies with a independent faculty or separate compensation structure,; a second model is to pay faculty overload salaries,; while a third approach offers faculty a percentage of the revenue generated from the courses. Each response has strengths and weaknesses dependent on the institutional context in which they are implemented.

While aspects of these three models may work well for individual institutions, the position offered here is that of a differentiated staffing model. This simply means that an individual faculty member would become part of an instructional team comprised of specialists in different aspects of the distance education provider responsibilities. Each of these team members, (e.g. subject matter expert, course manager, video producer, instructional designer, evaluation designer, administrative and technical support personnel) would negotiate compensation based on their contribution to the project. Part of the negotiation on the part of the faculty would be a decision as to whether the tasks were part of their basic teaching load, an overload, or a form of service for which supplemental compensation could be provided. The team approach guarantees multiple inputs into the development process, does not infringe on academic freedom, reduces the burden of distance learning on the individual faculty, and creates a common practice from which a standard design quality emerges without inhibiting creativity.

References

Willis, B. (1994) *Distance Education strategies and tools*. Englewood Cliffs, NJ: Educational Technology Publications.

A Web Interface to Facilitate Traditional and Distance Student Interaction in a Problem Based Learning Setting

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Abstract:

We created a web site to support a sophomore/junior level class (ANSC/FREC/PLSC 270) on the Science and Socio-economic Issues of Biotechnology. The primary objective of this course was to increase and expand the knowledge of biotechnology in agriculture. The course used an interactive website to team distance students with traditional "in-class" students to complete case studies in a problem based learning approach to the material. By working together, traditional and distance students gained the benefits of problem based learning, experienced a team approach to the material and generated insightful discussions on the various scientific, ethical, and economic issues raised in the class.

Students are more likely to retain and apply knowledge appropriately when concepts are coupled with applications (Boud and Feletti, 1991; Dunkbase and Penick, 1990). Our goal was to provide an enhanced learning experience for both distance and traditional students taking Biotechnology: Science and Socioeconomic Issue.

The class used problem based learning (PBL) case studies. Students work on case studies, in groups that include both traditional and distance (geographically dispersed) students. The course is taught to traditional students in the classroom and to distance students via videotaped lectures. A USDA Challenge Grant funded this course's design and implementation. The major challenge of the course was to teach a PBL course to distance *and* traditional students working together. The web site facilitates the interaction between traditional and distance students and successfully combines the use of PBL and distance learning in the class.

The web site (http://bluehen.ags.udel.edu/biotech) includes the syllabus, all lectures, homework assignments, hundreds of links to sources of information on biotechnology, case studies and technical computer support pages. The website's "message center" (modified discussion board) is the primary mode of communication for the groups on the web site. The message center had to meet several criteria to be effective. It had to be automated, provide security without requiring user accounts on the server, be easily accessible and easy to use.

The course was taught as a series of lectures, each given by a different expert. The instructors gave their presentations in PowerPoint. The presentations were videotaped for the distance students and the PowerPoint presentations were converted to html and made available on the website. The lecture section of the web site was restricted (by password) to registered students.

Links to sources of information were divided into several sections including journals, research centers, genomic databases, jobs, software, transgenic plants and animals, EST, cloning and many others. We hired an honors student to search the web for biotechnology links, evaluate them and write a short description. This section of the web site is accessible to everyone.

The message center is divided into 6 sections, one for each group. Members may only read the discussion and post to their group's message center. Users were assigned user names and passwords to restrict access to the message center. We chose not to provide students with accounts on the server because it is also a file server for the school's administrators. We felt that granting students accounts on this machine would be an unnecessary risk. Security was implemented with basic HTTP authentication. This protocol allowed us to create groups and grant access to sections of the site based on membership in those groups.

We chose HTTP authentication over Java or Javascript because HTTP authentication is supported by the vast majority of browsers. We don't know what computers or browsers students are using so we chose the most widely supported method.

The message center is extremely easy to use. Students simply access the page, click on the message center and enter their username and password. At that point they can read other users' messages and post their own. For students that are not familiar with computers and the Internet we provide extensive technical help including sections on connecting with ISPs like AOL and Erols.

Students in an honors section of the course were trained to facilitate the on-line discussions. These students "broke the ice" for the other students in the group and encouraged participation. Honor students indicated that the primary obstacle to other student's use of the site was technical inexperience. We found that once a group member began posting messages, the other members quickly followed with their own messages.

Students completed a survey *Attitudes about Biotechnology* and the *Kolb Learning Style Inventory* before taking the course. They completed the same survey after taking the course. The questions on the survey probed both perceptions of biotechnology and knowledge of biotechnology. The results of the surveys from the past 3 years indicate that students' understanding of the scientific material increased after taking the course, but many students still harbored concerns about the risks and ethical issues involved in many applications of biotechnology.

Preliminary results also show that distance students had more contact with the instructors and classmates than they would otherwise have had and all students had a more active learning experience.

References:

1. Boud, D. and Feletti, G., eds. (1991) *The challenge of problem-based-learning*. St. Martin Press.

2. Dunkbase, J.A. and Penick, E. (1990) Problem solving in the Real World. *Journal of College Science Teaching*. 19(6):367-370

A Practical Approach to Authoring Hypermedia Composites Used for Web Applications

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Abstract: This paper gives an introduction to modeling of hypermedia composites used for structuring of web-materials. In the introductory part we explain the need for a data structure such as hypermedia composite in order to provide better characterization and construction of hypermedia-materials. In the second chapter we bring a description of hypermedia composite model. Third chapter tells how to create such a composite and how can it be used. The conclusion chapter brings a short comparison of our approach to authoring web applications and other tools used for the same purpose.

1. Introduction

The requests on web applications today are growing fast: the idea is to give the end user a possibility to understand a presentation easily and quickly , prevent the user from "getting lost in hyperspace" , and at the same time the application should allow the author to easily reuse presented (created) material, create new web-materials and produce a new application [Maglajlic et al. 1998].

In order to create a hypermedia application running on the web the author of a such application has to define and compose some building blocks which can contain a lot of actual multimedia documents (units containing hypertext and multimedia materials together). For that purpose we propose here a usage of hypermedia composites.

2. Hypermedia Composites

Hypermedia composite can be seen as a basic building block of a hypermedia application. An author has a number of primitive multimedia/hypermedia documents which he/she combines into a hypermedia composite. The created composite can be further combined with other documents and/or other hypermedia composites to produce a more complex hypermedia composites. Each hypermedia composite has its own internal structuring mechanism, which defines, for example, the number of documents that can be members of this composite, can other composites be added as elements, how the elements of this composite are interrelated in means of computer-navigable links, which operations can be applied to this composite and its elements (open, save, delete, etc.) and a number of other attributes which can be used to describe the composite. Moreover, we should understand hypermedia composite as an instance of a well-defined data type. The data type definition indicates types of the elements of a hypermedia composite and operations that may be performed on the composite and/or its elements. Thus, we can say that we have different types of hypermedia composites which characteristics and the behavior are predefined in some way and that we have instances of these types that actually hold the data, as much similar as we can speak about classes and objects (instances of these classes) in object-oriented programming languages.

After a creation of some number of such composites it is not hard to combine them into a structure recognized by a hypermedia system (e.g. an information server based on a hypermedia technology).

3. Creation Procedure

A creation procedure of a hypermedia application using hypermedia composites can be seen as a three stage process. First we define a single composite using a particular application for data definition, an application which allows specifying the attributes of the composite and operations that can be applied to its units. For example, we can say that our composite has an attribute which tells it is a teaching course, corresponding units which actually make this composite are title, short introduction, chapters overview and chapters repository.

Let us say that a unit characterized through a particular attribute as a chapter repository has as its contents chapters - which are again hypermedia composites with particular units, e.g. a title, an abstract and contents. Because chapter repository unit can have several objects as its content, the particular operation applied to this unit should than an "add" operation -it means, we allow adding more documents to this repository.

After the composite definition process, as a second phase, the author can supply the composites with an actual contents using an application which recognizes the composite as its template and has an access to a multimedia documents resource directory which can be a local hard-drive or an information server.

The third step in this approach is specifying a visualization procedure for defined hypermedia/web materials. The author can use again the special application which makes it possible to design a final outlook of a hypermedia application and specify the linking structure between different composites. A produced structure can be mapped e.g. to HTML or XML, and special created Java-applets, JavaScript or XML can be used for navigation through and between the composites.

4. Conclusion

Using this approach we can achieve the aim of giving an user a web application which is strictly context-oriented. With predefined visualization structure of composites it is hard to "get lost in the hyperspace". On the other hand, the author can use once defined composites to combine them into a new one and create a new hypermedia application. Usage of specially defined application for composite creation and visualization gives the author freedom to functionally define a hypermedia/web material (using operations on the composite units) and to characterize it through the usage of composite attributes.

7. References

[Maglajlic et al. 1998] S. Maglajlic, H. Maurer and N. Scherbakov: Separating structure & content: Authoring of educational Web applications. - World conference "Educational Multimedia and Hypermedia" ED-MEDIA'98, Freiburg, Germany, June 1998, pp. 880 -884.

Overview Of Groupware And The Groupware Market

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Abstract: Groupware is a collection of different electronic technologies that supports communication, coordination, and collaboration among two or more people. Groupware seeks to take advantage of the fact that workers are connected together electronically. As client server architectures have evolved, groupware technologies have matured and expanded. Two of the most commonly used synonyms for groupware are collaborative computing and work group computing. This paper discusses what groupware is, lists the major components, the benefits and disadvantages of using it, where it makes sense to be installed, and lists the major vendors in the groupware area.

1. What is Groupware?

Groupware can be defined as technologies that allow people to work together electronically to become more productive and increase communication regardless of physical location or time. Groupware products are collaborative products that allow people to work together and share information in a variety of ways. Since groupware technologies have an impact on the way people work, before a company evaluates and implements any type of groupware technologies it is essential to ask users for their input. People do not like being told what to do or how to do it. In order to assure a successful implementation it is essential to get the users involved. It is important to help users understand the benefits that groupware technology can provide them. It is also important not only to get users' input but also to provide them with training on how to use the new technology effectively so that they will use it and see the benefit first hand.

There are five fundamental technologies that groupware builds on:

- Electronic mail
- Calendaring and scheduling
- Workflow
- Real time and non-real time conferencing
- Electronic meetings

No single groupware product incorporates all of the above technologies but products are becoming more advanced and are incorporating new technologies while improving the technologies already included. The three main vendors and products in the groupware area are:

- Lotus Notes and Domino Server
- Microsoft Exchange Server, Outlook, and NetMeeting
- Novell Groupwise

What are the benefits and problems of using Groupware?

There are several benefits to implementing groupware technologies into a company. The benefits are: increased information access, eliminates redundant information, improves business processes, automates routine processes, improves decision making, and increases organizational learning. Along with the benefits of any new technology there are also some problems that can be encountered. Some of the potential problems are: not enough properly trained people, lack of upper management support, no clear business objective, lack of understanding of what groupware is and what it can do, and lack of standards.

Where should Groupware be employed?

Industry analysts are predicting that the groupware market will become a multi-billion dollar industry by the end of this century. This leads to the questions: Where should groupware be implemented? and Who should implement groupware? The answer is generally the typical IT answer: it depends. Many companies have already started pilot projects and some have fully implemented groupware technologies in their companies. Some companies have decided to use Lotus Notes and Domino Server as their groupware choice.
A few examples follow:

- NYNEX decided to implement Lotus Notes to bring the data warehouse to the desktop. According to Carl Fiore, managing director of NYNEX's Marketing Information Systems division, by providing access to the data they were able to empower the marketing departments to make faster, better, and easier decisions.
- Prudential Insurance Company upgraded its worldwide messaging infrastructure from IBM Mainframe-based PROFS to Notes. Not all companies select Lotus Notes and Domino Server.

These are just a few examples of companies that have implemented some type of groupware technologies and achieved measurable benefits thanks to careful planning and a clear understanding of how the technology would support business processes. These are some tips to follow to ensure success in implementing groupware:

1. Get top management involved.
2. Implement the groupware technology during a pilot program in one area of a department, not the entire organization at once.
3. Get users involved so that they are more willing to accept the change. Remember, users are very resistant to change. Have open communication and be prepared for resistance.

2. Major Players

There are currently three main players in the groupware market: Lotus Development Corporation, Microsoft Corporation, and Novell Inc. According to industry research at the end of 1997, Lotus Notes had 15 million users, Novell Groupwise had 8 million users, and Microsoft Exchange Server had 7 million. Industry experts are predicting that by the year 2000, Lotus and Microsoft will have equal market share. Needless to say it is expected that the groupware market will go through continuous change for the next few years.

3. Conclusion

Having gone through corporate downsizing in the early nineties, many companies still had the same amount of work or even more work to accomplish but with fewer people. So how were companies going to do this? Many companies turned to their information technology architectures as the answer. Many companies started to move from a mainframe architecture to a client server architecture. As client server architectures have developed and matured companies have been provided with a great deal of flexibility, have empowered employees to meet a lot of their own information needs, and have allowed for employees to communicate and collaborate in ways that were not possible before. One new area of computing that grew out of client server computing is groupware. As educators in the Information Technology field we must stay current on what is happening within industry so that we can develop new courses and provide the best and most current education to our students.

Interactive Courseware Quiz Creator: An Adaptive Zero-Programming Content Development Tool for Students Learning and Testing via Intra/Internet

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Abstract: We should be prepared for the rapid progress of multimedia technologies in terms of extending the life span of both developed programs themselves and the products created by these programs. Otherwise, our hard-won achievements may become rapidly obsolescent, due to rapid changes in technology, before we are able to put the programs and/or the products to practical use. This paper describes the "Interactive Courseware Quiz Creator," which allows teachers to create and publish several types of quizzes to the intra/internet, without prior programming knowledge. As well, the program's ability to adapt itself to rapid technological change is presented in detail.

1. Background

The rapid progress of multimedia technologies may make computer programmers' hard-won achievements rapidly obsolete. Computer programmers may be forced to become compliant with new technologies before they are able to put their products to practical use. Our Interactive Courseware Quiz Creator (ICQC) enables teachers to design their own educational software with zero-programming knowledge: no specialized computer programming skill is required on the part of teachers [Matsuno, Tsutsumi & Ushijma, 1999]. Additionally, in order to counterbalance rapid changes in technology, we are developing the Web-based ICQC to adapt to multimedia technology innovations. This conceptual design feature should extend the life span of both ICQC and coursewares created using ICQC.

2.Description

As shown in Figure 1, ICQC consists of several programming parts and a "Programming Quiz Module Database"(PQMD). Programming parts are divided into a "CORE-PROGRAM" and several programming quiz modules (PQM1,...,PQMn). The "CORE-PROGRAM" includes several common sub-programs for each quiz module (PQM). We have designed five types of quizzes: 1) Multiple choice, 2) Fill-in blanks, 3) Sequencing (arrange -n mixed up items into proper order), 4) Connect -n to -n items, and 5) Check true/false. Each type has its own quiz module, which helps teachers to create new quizzes of each type, maintains the PQMD, and generates Web-based quizzes with DHTML and JavaScript. In Figure 1, for example, PQM1 illustrates the "Multiple Choice" type quiz. When a teacher tries to create this quiz, the notice in the box named "QM1:" at the top of Figure 1, will be extracted from the PQMD. In this case, the extracted notice shows that a)QM1 is a "Multiple Choice" type quiz, b)The number of necessary data entries for creating this type of quiz (four), c) The allowable media types for the questions are: "Text," "Sound," and "Video," and so on. Additionally, the PQMD stores media attributes and associated object modules, such as an object module for QuickTime movies. By adopting this modular organizational method, it will be easy for users to adapt to new technology, if (as in a typical case), they are adding new attributes within program modules associated to the PQMD, as new multimedia technologies appear. Over and above that, since each quiz module is independent of the other modules, it will be easy for a programmer to add/update a module if a teacher asks the programmer to add a new quiz -type module, or requests software upgrades.

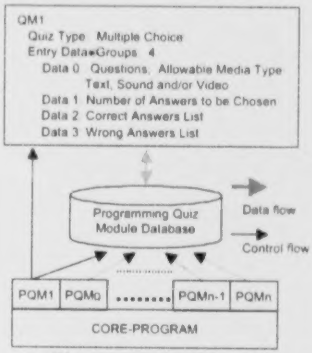
QM1
Quiz Type Multiple Choice
Entry Data•Groups 4
Data 0 Questions; Allowable Media Type Text, Sound and/or Video
Data 1 Number of Answers to be Chosen
Data 2 Correct Answers List
Data 3 Wrong Answers List
Programming Quiz Module Database
Data flow
Control flow
PQM1
PQMq
PQMn-1
PQMn
CORE-PROGRAM

Figure 1: ICQC Architecture

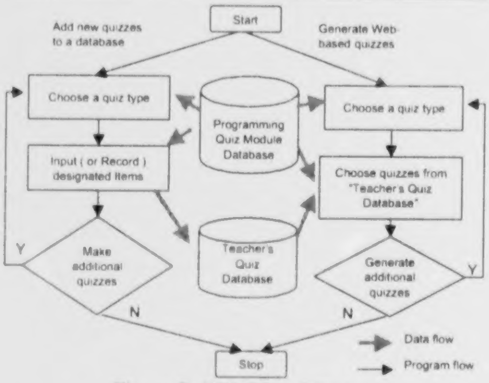
Start
Add new quizzes to a database
Generate Web based quizzes
Choose a quiz type
Programming Quiz Module Database
Choose a quiz type
Input (or Record) designated items
Choose quizzes from "Teacher's Quiz Database"
Make additional quizzes
Teacher's Quiz Database
Generate additional quizzes
Y
N
N
Y
Stop
Data flow
Program flow

Figure 2: ICQC Use Flow

3. Generating Web-based Quizzes

As far as generating web-based quizzes is concerned, ICQC is divided into two phases (see Figure 2). In the first phase, a teacher has to create new quizzes and store them in the Teacher's Quiz Database. In the second phase, the teacher has to choose the number of questions he/she wants on his/her quiz, from the database. Then, ICQC automatically creates the Web pages. We will next show the process in detail.

a) Phase 1: Creating New Quizzes

In order to create new quizzes, as shown in Figure 2, a teacher has to first choose a quiz type. Then ICQC will prompt the teacher to input the necessary data. When a teacher chooses "Multiple Choice," for example, ICQC will show the teacher an "input form," which prompts for four groups of data: 1)The questions, 2)The number of correct answers to be chosen, 3)The correct answers, and 4)The wrong answers. Since ICQC provides teachers with a simple text editor and a sound recorder, they can both input text and record sound clips. Of course, they can use any type of media they have already prepared in advance. By clicking the "Add" button , after inputting the necessary data, the teacher can add the new quiz to the Quiz Database.

b)Phase 2: Generating Web-based Quizzes

The right side of Figure 2 shows the method of publishing Web-based quizzes. First, a teacher has to choose a quiz type, and then ICQC will show the contents of the Quiz Database. Second, by clicking on database entries, the teacher can add quizzes to the quiz list. Finally, the teacher can publish Web-based quizzes with DHTML and JavaScript by clicking the "Web" button. For example, if a quiz type is "Multiple Choice," ICQC will shuffle the correct answers and wrong answers each time it creates Web pages. This feature is useful in preventing students from memorizing answer locations in successive quizzes. Additionally, ICQC provides teachers with several features, such as making 'blanks' in "Fill-in blanks" type quizzes, and allowing teachers to publish quizzes in a "Practice Mode" or "Test Mode."

4. Discussion

As we mentioned above, we are developing ICQC with two overall themes: one is to give an adaptive function to allow for the rapid change of multimedia technologies, and the other is to allow teachers to create their own Web-based quizzes with zero-programming. At present, we have developed the "Fill-in blanks" section and "Multiple Choice" section. If we adopt the CGI design, we can provide more useful features, including students' study histories. Although there are administration and security issues associated with CGI implementation, if a significant number of teachers wish to use CGI to manage their students, we are preparing to build this function into ICQC.

Reference

Matsuno, R., Tsutsumi, Y., & Ushijima, K. (1999). A-MATE: A Multimedia Authoring System for Teaching ESL. *ED-MEDIA/ED-TELECOM 99*, Association for the Advancement of Computing in Education., 1237-1238.

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Information Environment for School Leader Preparation: Web-Based Software for Preparing Reflective Educational Leaders

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Abstract: The Information Environment for School Leader Preparation (IESLP) is a web-delivered information environment and problem-based instructional system. IESLP provides users with access to an extended set of data from actual community and school environments that serve as a realistic backdrop in front of which a wide variety of problem-based learning activities can take place. IESLP problem exercises encourage self-directed learning and skill building responsive to the real world tasks and genuine problems administrators are faced with in contemporary schools. The system fosters the use of web resources and other information technologies in the identification and framing of problems, and the generation of proactive and collegial approaches to intervention. Thinking and acting in the real and imperfect environments provided by IESLP parallels the limitations and stresses of work in the real world and prepares future school leaders to deal with all types of situations in which they might eventually find themselves.

As in other realms of education, a need has been identified to reconstruct the professional preparation of educational administrators so that it is more closely tied to the complex problems facing practitioners [1]. In response to this need, the University of Missouri-Columbia Center for Technology Innovations in Education has developed a web-delivered information environment and problem-based instructional system that uses the tools of modern technology to place educational leaders in the virtual halls, classrooms, and boardrooms of actual public schools. It draws practitioners and would-be educational leaders into ways of thinking that incorporate the use of technological resources, tools, information, theory, and research. It creates a demand for the capacity to use information technology to make reflective, information-based decisions and engage in collegial problem finding and intervention. It is an authentic approach to acquiring knowledge, skills, and dispositions appropriate for leadership in contemporary educational organizations. The IESLP project was conceived by the University Council for Educational Administration (UCEA) to stimulate a revolutionary departure from predominant patterns of administrator preparation using authentic avenues for teaching and learning school leadership and to encourage the use of information technology in the practice of school leadership.

Problem-based learning is a pedagogical approach for posing significant problems in the context of real world situations and providing resources, guidance and instruction to learners as they build content knowledge and problem solving skills and strive to devise viable solutions. IESLP fosters the use of web and other information technologies to build skill in identifying problems and opportunities, generating proactive solutions, encouraging collegial approaches to intervention and the acquisition of knowledge, skills, and dispositions appropriate for leadership in contemporary educational organizations. The IESLP approach challenges learners to use technological resources to solve problems and demonstrate learning through varied authentic activities.

IESLP is not a computer simulation. Computing technology is an integral part of using IESLP; however, instead of acting on problem exercises in a simulated computer environment, IESLP exercises are worked on by people in face-to-face groupings, using technology like they do or will in their actual work-lives. That is, students use technology as a tool to retrieve information and data, analyze data, communicate, and produce products. However, unlike a simulation, in IESLP this is done in the context of human work groups, subject to the uncertainties and limitations of those groups, just as teams of administrators do in real educational settings. IESLP, therefore, is much more than a traditional simulation could be. It is a comprehensive information learning environment that brings to learners and instructors the genuine complexity of contemporary schools. While older style simulation systems tended to define school administration in terms of coping with problems that find administrators, the IESLP system is based on another idea: *that the most critical skills administrators can develop are those having to do with problem identification, problem framing, problem intervention, and problem prevention.*

IESLP's information and learning environment creates a realistic backdrop in front of which a wide variety of problem-based learning activities can take place. Three essential components constitute the strength and uniqueness of the IESLP information environment: the problem exercises, the community and school environments, and the tools and resources.

IESLP learning begins with authentic problems of professional practice surrounding K-16 education with a particular K-12 emphasis. Problems in educational administration are often ill structured: there are no clear-cut right or wrong answers. Ill-structured problems are those that involve several simultaneous conceptual structures and are irregular across cases. IESLP problem exercises vary along a continuum from virtually unconstrained problem identification to highly constrained problems. In problem finding exercises learners are asked to define and shape the problem with little direction. Thus, these problem exercises take the form of very general and ill-structured charges. These ill-structured assignments are unconstrained such that the problems as well as the solution are to be discovered. In contrast, problem presented exercises provide learners with more information, more constraint, and create rather specific expectations about products required of individuals and learner groups.

IESLP provides users with access to an extended set of data from actual community and school settings that serve as a backdrop for problem/opportunity discovery, examination of relevant research and best practice knowledge, and group negotiation of decisions about appropriate interventions. The information provided in the community and school environments is comprehensive and provides context in which students can engage in problems of practice. The environments are fictitious community and school web sites constructed with authentic information collected from actual schools and their surrounding communities, including community demographics, district information, school characteristics, and information on facilities, budget, students, parents, and teachers. The data in the environments are real, but modified to protect identities. The IESLP community and school environments vary by educational level and community type. Data contained in the first environment included in the IESLP system were collected in a rural Oklahoma public school district. Future environments currently under development will include urban and suburban public school districts and the communities they are each situated in.

IESLP includes links to the appropriate analytical tools and research in education and the social sciences, and fosters the routine and intelligent use of both. Consistent with the notion of providing rich, authentic learning experiences that include skill learning objectives, IESLP exercises incorporate information management, data analysis, decision-making, presentation, etc. Many of the tools required to complete tasks are available on the web, and a number of them at the *Planet Innovation* web site. Also developed at the Center for Technology Innovations in Education, Planet Innovation provides tools that support decision-makers as they plan, implement, and evaluate programs, particularly K-12 technology planning, by supporting communication and informed choice making. To facilitate this process, Planet Innovation developed an on-demand web environment through which individuals could choose web solutions based on their needs and, if desired, form groups to work in a distributed environment.

Thinking and acting in the real and imperfect environments provided by IESLP parallels the limitations, stresses and processes of work in the real world and prepares future school leaders to deal with all types of situations in which they might eventually find themselves.

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[1] Report by the California Commission on Teacher Credentialing in March, 1993, entitled *Preparation, Induction, and Professional Growth of School Administrators.*

ENiSpace: Evaluating Navigation in Information Spaces

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1. Introduction

Traditional methods of evaluating usability such as heuristic evaluation and cognitive walkthrough do not address all issues relating to navigation. This is despite the fact that designing effective navigation within electronic spaces is now considered an important issue.

The research presented here describes the development of the ENiSpace system which is a software package aimed at allowing people to evaluate the navigational properties of electronic spaces. The software includes reporting features and supporting documentation and is based on a checklist. ENiSpace is also intended to be used to inform the design of electronic spaces.

2. Disorientation within Electronic Spaces

The increasing use of the web as a means of mass information storage and retrieval has led to a number of studies of the navigational problems encountered by users. The three main problems are: ***not knowing where to go next, knowing where to go but not how to get there*** **and** ***not knowing the current position relative to the overall hypertext structure.***

One study [Foss 1989] indicated that there are three observable symptoms of becoming disorientated within electronic spaces: ***navigational Disorientation*** (a person can be seen looping or taking inefficient paths), ***embedded digression problem*** (the screen may become disorganised and cluttered) and finally the ***art museum problem*** (the person does not study any part of the environment for a period of time. Instead they are observed merely scanning it).

Taking this further it is possible to see that (as an example) the overuse of the back button may be a result of people looping and taking in efficient paths, even when other navigational aids are provided on page. Therefore in order to combat this and other navigational problems, we need to provide navigational cues at appropriate times.

3. ENiSpace

ENiSpace seeks to cover the three main aspects of navigation: ***object identification***: where people gain an understanding of the space and objects within it [Benyon et.al. 1997], ***wayfinding***: orientating towards a specific point [Downs at. al 1973] and exploration: where no specific destination is required. Therefore when designing an electronic space we must be aware not only of supporting task specific activities (wayfinding) but also the ability of people to explore the environment and identify objects. In addition we must also look at ways of supporting all three at any given time during the navigational process. The framework [Spence 1998] highlights four parts which encompass object identification, exploration and wayfinding. The components are ***browsing*** (this is similar to exploration however the person has in imprecise goal), ***context modelling*** (the creation of a mental map of the environment), ***gradient perception*** (the weighing up of various route options) and finally strategy formulation (this is the formulation of strategy used by the person when browsing).
In addition to supporting the models of navigation ENiSpace also seeks to build upon the research into the environmental knowledge which people have. Therefore ENiSpace seeks to support the three type of environmental knowledge [Siegel et. al. 1975] **landmark** where users navigate by landmarks, **route**: where they use a set procedure, and **survey**: where they use mental maps of the environment.

ENiSpace covers four main areas which attempt to inform the designer on how to avoid potential navigational problems. For example the section ***signs within the environment*** specifically covers the provision of information signs (to aid in object identification). In addition it also covers directional signs where the aim is to provide route and other information which will prevent the problems highlighted earlier, as well as warning and reassurance signs. In another section ***conceptual and physical structure*** the method looks at the ability of the environment to convey content and structure through the way the objects are distributed as well as the use of landmarks. One particular departure from existing methods is the examination of the dynamic aspects of the environment. The third section ***users in the space*** deals with enjoyment and also how they interact with other agents within the space (also known as social navigation). The final section ***navigational methods and aids***, examines the issues relating to shortcuts, maps and overview structures. In addition within all these sections issues relating to metaphor, imagery, analogy and sound are discussed. Further to this each section covers how the cues will effect the users current navigational mode, knowledge of the environment and ability to remain orientated.

As can be seen the method marks a stark change to the traditional method of usability as it examines the impact of specific cues on the users in particular the use of social navigation techniques [Munro et. al. 1999]. The aim being that by incorporating aspects of social navigation the navigational process will be easier and become more natural.

4. Conclusion and Future Directions

ENiSpace offers the designers of electronic spaces a method which can be used to inform as well as evaluate design. In addition its rich set of questions, structure and supporting documentation provides a highly focussed method which also can provide possible suggestions for improvement. At the time of writing it had been tested on a number of 2D and 3D environments.

5. References

[Benyon at. al. 1997] Benyon, D. R. and Höök, K. (1997) *Navigation in Information Space*. In S. Howard, J. Hammond, and G. Lindegaard (eds.), *Human-Computer Interaction, INTERACTi97*, Chapman & Hall.

[Downs et. al. 1973] Downs, R. and D. Stea (1973). *Image and the Environment*. Chicago: Adeline Press.

[Foss 1989] Foss, C.L. (1989). *Tools for Reading and Browsing Hypertext*. Information Process and Management. 25: p. 407-418.

[Munro at. al. 1999] Munro, A., Höök, K., Benyon, D.R. (eds) (1999) *Social Navigation of Information Space*. Springer

[Siegel at. al. 1975] Siegel, A.W. White S.H. (1975). The Development of Spatial Representations of Large Scale Environments. *Advances in Child Development and Behaviour*. pp9-55

[Spence 1998] Spence, R. (1998) *Navigation in the Real World*. In proceedings of the Workshop on Personalised and Social Navigation in Information Space. Roselagens Parla, Sweden: Swedish Institute of Computer Science.

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Web Based Teaching: - Do Learning Styles Matter?

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Abstract

This paper describes how an area of learning theory, specifically learning styles, is used to evaluate the learning outcomes of a web based course The Kolb (1985) Learning Style Inventory was administered to a group of 70 accounting students who had no prior experience with web based learning. Results are tentative, however it appears that there are learning style differences with respect to preference for asynchronous web based courses and there are improvements in overall student grades for some learning styles when using such courses. If replicated this study has an implication for university educators and their corporate counterparts due to the range of different dominant student learning style preferences across faculties.

Results

The results of the study are presented in Tables 1 - 5:

The first table shows students results in the unit AFM 272; Accounting Information Systems grouped by each of the four learning styles. Results are presented as letter classifications with numerical ranges shown.

	Accommodator	**Diverger**	**Converger**	**Assimilator**
High Distinction 85+	0	0	0	19%
Distinction 75 -84	20%	35%	22%	10%
Credit 65 -74	54%	35%	55%	24%
Pass 50 -64	13%	17%	12%	28%
Fail <50	13%	4%	11%	19%
Withdrawn	0	9%	0	0
	100%	100%	100%	100%
Average **N = 70**	Credit N = 15	Credit N = 25	Credit N = 9	Pass N = 21

Table 1 Results in AFM 272 Accounting Information Systems

A grade average for each learning style based on past results in all courses was then computed. This information is shown in Table 2. Data from Table 2 is used as basis for comparison with various components of web based learning as shown below in Tables 3 -5

	Accommodator	**Diverger**	**Converger**	**Assimilator**
High Distinction	0%	0%	0%	5%
Distinction	13%	36%	22%	14%
Credit	20%	24%	56%	28%
Pass	54%	34%	11%	48%
Fail	13%	4%	11%	5%

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Withdrawn		2%		
	100%	100%	100%	100%
Average **N = 70**	Pass N = 15	Credit N = 25	Credit N = 9	Pass N = 21

Table 2 Average results for all other courses

Table 3 shows student use of the web based course by learning style and average number of hits.

Table 3	**Average Number of Hits**			
	Accommodator	**Diverger**	**Converger**	**Assimilator**
Average no of hits	347	458	353	288

Table 3 Average Number of Hits by Learning Style

Table 4 presents a synthesis of student use of the asynchronous web based material by learning style, results and number of hits.

	Accommodator	**Diverger**	**Converger**	**Assimilator**
High Distinction	0	0	0	186
Distinction	872	678	242	611
Credit	205	282	131	132
Pass	318	382	142	367
Fail	280	69	143	266
Withdrawn				

Table 4 Learning Style, average number of hits and associated grades

Table 5 presents a comparison between the number of hits; differences in results gained and learning style.

	Accommodator	**Diverger**	**Converger**	**Assimilator**
High Distinction	0%	0%	0%	14%
Distinction	7%	-1%	0%	-4%
Credit	34%	11%	-1%	-4%
Pass	-41%	-17%	1%	20%
Fail	0%	0%	0%	-14%
Withdrawn		7%		

Table 5 Student Performance Differences between AFM 272 and Average Grade by Learning Style

Conclusion

Early results suggest that there *are* learning style differences in student use of asynchronous web based material and that there is a relationship between use and enhanced performance. It is acknowledged that conclusions can only be tentative, given the sample sizes in each group. Nevertheless, if replicated with a larger sample size the results would have implications for accounting educators where studies have shown dominant student categories are Converger (Lillie 1990) and Accommodator (Willcoxen 1996, Kolb 1976). There is also relevance for educators in the arts where the dominant student category is Diverger and economic/sciences where the dominant learning style is Assimilator.

The drive by universities world wide to develop flexible learning programs which are both educationally effective and time and cost efficient means that the potential for research, in the relatively new area of web based teaching, are numerous. It is important that there is continuing evaluation of all aspects of web based teaching and learning if the promise of web based instruction is to be fulfilled.

PsychExps: A Web-based Cognitive Psychology Laboratory

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Abstract: PsychExps is a public, on-line cognitive psychology laboratory that has been developed to address problems of cost and periodic obsclescence of both equipment and software in department-maintained undergraduate psychology labs. Located at http://www.olemiss.edu/projects/PsychExps, the laboratory is being developed using Authorware®, a relatively easy-to-learn multimedia authoring tool, and Shockwave, a free technology that makes interactive Authorware® programs deliverable over the Internet to both PC and Mac users.

The PsychExps Site

The PsychExps project to establish a public, on-line psychology laboratory for use in collecting data from interactive psychology experiments began in 1997 and the site became operational in Fall, 1998. By May 1999, 45 classes at 39 different institutions had registered as users and students in these classes had generated 1464 data records.

The lab features a set of experiments appropriate for use in psychology laboratory classes. Included among them are experiments involving visual illusions, mental rotation, face recognition, pitch memory, and word recognition. Participants conduct the experiment of their choice on-line then submit their data to the data archive where it is appended to the data already collected for that experiment. Any portion of the data archive can be downloaded as a text file for analysis--the whole archive, an individual data record, the records for an entire class, or the data for a particular semester in a particular year. This filtering is performed using an ASP page that assembles the data from an Access database.

In addition to the data downloads, PsychExps offers Excel macros that are designed both for those who want one-click data processing and for those who want to create a tab-delimited data file that can be submitted to a standard statistical package. The product of the macros is a workbook with sheets for each research participant and one overall summary sheet. The individual data sheets give raw data for each participant along with individual summaries. The overall summary sheet lists summary results for each participant along with descriptive statistics for each experimental condition.

Authoring Tool

Whereas Web delivery of interactive experiments could be created using Java, JavaScript, or Visual Basic Script, we have elected to use Authorware a multimedia programming tool from Macromedia that we have found to be ideal for developing psychology experiments. The experiments are executed using a free plug-in known as the Authorware Web player, which is best obtained by linking from our site. The plug-in has been under constant development since first being introduced as "Shockwave for Authorware" but Macromedia now offers automatic updating so that new improvements will be obtained automatically once the WebPlayer is installed.

Can You Trust the Data?

Skepticism regarding the feasibility of delivering experiments via the Web focuses on the absence of control over both the research context and the research equipment. In addition there is concern about the capacity for computers to deliver and record the experimental events as planned, particularly with regard to tachistoscopic displays and response time measures. Our experience indicates that the skepticism is unwarranted in that the data from our Web-delivered experiments mirror lab-based findings, even for experiments that require precise timing of displays and responses. Textbook results are obtained not just for within subject effects but for between subject effects as well. These results suggest that existing technology is adequate to permit Web-delivery of many cognitive and social psychological experiments and that the added noise created by having participants in different settings using different computers is easily compensated by the sample sizes achievable with Web delivery.

Development Plan

A primary reason for choosing Authorware over other programming tools is that its icon-based interface makes it relatively easy for non-programmers to either make changes in existing programs or create their own. Ease of learning was important to us because our goal is that PsychExps become a communally owned and developed site. Toward that end, we permit users to download the Authorware code for existing experiments in hopes that some will take our experiments, modify them to their needs, and resubmit them to the site as novel experiments. In addition, we have begun training faculty from other institutions to use Authorware to develop experiments they would like to place at the site. By the end of Summer 2000 40 faculty will have been formally trained in workshops we conduct and we are actively seeking other means (e.g., off-site training, CD-ROM and text materials, as well as the development of experiment wizards) of giving psychology instructors the tools they need to develop their own ideas for experiments.

Our commitment to the communal development model for PsychExps is based on the belief that communal site development is essential to long term viability. The intense efforts required to develop and maintain websites can produce burnout in the initial developers. Obsolescence will ensue unless there is a way to pass on the site to others, but for sites developed on a proprietary rather than a communal model, this may not be possible.

At PsychExps we hope to avoid obsolescence by enlarging the development team to a community of individuals with a vested interest in the site. In this way the site can have the longevity of journals, which are sustained and made continually relevant through the joint efforts of contributors, reviewers, and editors all of have a mutual interest in the journal's well-being.

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A Web-based System to Coordinate Examination Processing

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Abstract: The Department of Mathematics at the University of Auckland teaches about forty undergraduate papers at three stages. After marking examinations, the examination marks are combined with coursework marks, and overall grades are calculated. However, it is often necessary to apply a certain amount of scaling or variation of grade boundaries to ensure that pass rates are appropriate or that grades are reasonably consistent between papers. In this paper we describe a Web-based system we have developed to coordinate this process.

The Department of Mathematics at the University of Auckland teaches about forty undergraduate papers at three stages. After marking examinations, the examination marks are combined with coursework marks, and overall grades are calculated. However, it is often necessary to apply a certain amount of scaling or variation of grade boundaries to ensure that pass rates are appropriate or that grades are reasonably consistent between papers.

Until recently this processing was done more or less "manually": of course the calculations were done by computer (using the statistical package SAS), but the SAS scripts were edited by hand, and essentially one person was doing all the work. In some other departments, each examiner processes their own paper, doing their scaling using a spreadsheet program such as Excel. Both of these approaches have severe drawbacks: in the first, there is a significant bottleneck in the process, which could mean accepting results simply because there is not enough time to reconsider scaling. In the second approach, each examiner is working in isolation. While it is easy enough to ensure that pass rates meet quotas, it is hard to justify the scaling in terms of maintaining standards: is the pass rate low in a particular paper simply because a greater proportion of weaker students enrolled in it?

We have avoided both of these problems by adopting a system in which all the results are in a central database, which each examiner can access and manipulate using a Web-based interface. The interface consists of a number of CGI scripts. One advantage of using a Web interface in this way is that it avoids compatibility problems. Our department has a mixture of old and new Macintosh computers, Unix workstations and X-terminals, and a few PCs: all of these are capable of running at least some version of a browser such as Netscape. So long as the scripts produce reasonable HTML output, Netscape can take care of any compatibility issues. Another advantage is that the results lists are hypertext documents, and as such can have links to useful queries of the database. For example, each student's name in a results list is a link to a full history of that student's results in current and previous mathematics papers.

A brief overview of the system

There are essentially five parts to the process of generating examination results:

- getting (raw) marks into the system;
- combining the marks from various components to get an overall mark;
- listing the results, in full or in summary;
- comparing results with other papers; and
- scaling marks and/or varying the grade boundaries.

The first three parts are reasonably straightforward. Marks are either entered in an HTML form, or are entered in a spreadsheet which is then saved as a text file and uploaded. Once this has been done, and information such as the weighting given to the coursework and final exam have been supplied, results lists can be generated. These might be a full list of results by name, or a summary showing the number and percentage of students getting each grade.

Comparisons between papers

Of course, one form of comparison between papers is to look at the percentages of students who pass, or who get A grades, using the summaries mentioned above. However, a more useful comparison can be obtained by generating a scatter plot of all the students' marks in both papers, such as that shown in Figure 1 below

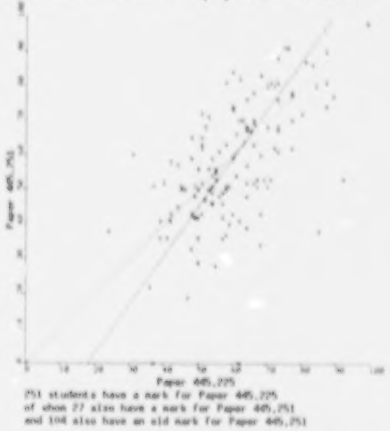

Figure 1: a scatter plot comparing performance in two papers

This plot shows a comparison between the performance in paper 445.225 with that in 445.251. Each + symbol represents a student taking both of these papers in the current semester, while the × symbols represent student who took 445.251 in a previous semester (this plot would be generated while considering the appropriate scaling for 445.225: thus it is not necessary to consider marks for 445.225 in previous semesters). This plot is a clickable image: if a user points their mouse at one of the + or × symbols and clicks, they will be shown the name of that student, together with a list of their marks in all mathematics papers in this and previous semesters.

Scaling

Examiners are able to adjust the results using any or all of the following:

- scaling the marks for an individual component of the examination mark (short answers, multiple-choice questions etc;
- scaling the total examination marks;
- scaling the overall marks; and
- changing the grade boundaries.

The use of CGI scripts rather than spreadsheets or hand-edited SAS scripts has another advantage here, in that it allows "sanity checks": marks cannot be scaled outside their range, the scaling function must be monotonically increasing, and grade boundaries must be increasing.

Availability

Interested readers can explore the system by going to the URL http://exams.math.auckland.ac.nz/guest .

The system was originally written specifically for the Department of Mathematics at the University of Auckland, but it is written in the freely-available scripting language Perl, so it should be possible to edit it to run at any other university with a similar examination system and a reasonably standard web server. Anyone interested in obtaining a copy of the scripts should contact the author.

Conclusions

Using a World Wide Web interface to the processing of examination marks has made a significant improvement on the convenience of the processing. Although the initial impetus for this system was to streamline the process, it has also opened up a number of possibilities for the analysis of examination results which were previously too awkward to achieve. Thus, what started as principally an administrative development has also had an impact on the teaching offered by the Department.

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A Nexus of Resources, Tools and Content: Using 3-D Animation and a Digital Image Library

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Abstract: The creation of educational multimedia is an arduous task for an instructor. In order for development to proceed, a nexus of skills, tools and infrastructure must be present. The experiment described here revealed that an investment in resource libraries, 3-D modeling and sequencing software can result in useful and well received educational tutorials, lectures and study aids. Availability of the proper mix of resources makes the task much less stressful for the individual instructor and can improve the quality of the product and reduce development time.

The mix of tools and capabilities described resulted from the author's efforts to produce educational materials for his large lecture courses in landscape architecture, a professional discipline strongly tied to visual and animated media for instruction. The successes and lessons learned are applicable to a wide variety of visually oriented disciplines and should be of interest to anyone involved in or contemplating the development of graphically rich educational media. Examples of image libraries, sound tracts, interfaces and the final tutorials, as well as student responses will be shared during the presentation.

This project began with my desire to incorporate 3-dimensional graphics into my classroom lectures and to provide student access to a variety of photographic images of real places. My motivation was heightened by a need to serve a class that I taught once a year in a room with 318 desks but with 600 students signing up. This level of demand can motivate any educator to seriously consider alternative methods to the usual fare of chalk board scribbling and slides. Something more efficient and more dynamic was needed.

The content I needed to convey included how the design of the physical aspects of human settlements responded to the natural environment and the social constructs of each culture covered in the course, throughout time. These relatively large units of analysis were unfamiliar to most students and they had difficulty comprehending the structure of a city from 2-dimensional images alone. Cities are decidedly 3-dimensional constructs in the real world and we experience them best by moving through them. While we rarely comprehend them as complete architectural entities while standing on the ground, as we move to a birds-eye perspective or an animated virtual fly-through, a completely different set of understandings becomes possible.

3-Dimensional Animations and Stills

What I needed was a way to reconstruct ancient cities and historic landscapes as 3-dimensional block models to help students understand the spatial organization and morphological patterns that evolved over time. The solution was to develop an on-line image library of still images of real places and link these images to dynamic, 3-dimensional block models that served both as an overview and an interface for accessing additional imagery and information about particular parts or aspects of a place's history.

The solution to how to present communities as 3-dimensional spaces came in the form of a nexus of evolving technology, tools and my own rising skill level. As a research team, we explored a variety of software applications to see which were the most intuitive and efficient for modeling cities and landscapes. Eventually we settled on several moderately priced modeling applications including MiniCAD™, Modelshop™, Infini-D™ and Bryce 3-D™. We found each of these applications to be best suited to a particular type of modeling, though all were fully capable systems on their own. We developed favorites. For example, MiniCAD™ (now Vectorworks™) produced the most accurate architectural models while Infini-D™ was especially good at animating and rendering and Bryce™ was by far the best at producing believable landscapes and backgrounds.

Web Based Digital Image Library

One of the more significant pieces of the digital resource puzzle was the development of a web based image library to provide the bulk of the factual visual content to the teaching and learning process. It was designed to be used with a video projector to deliver slides during lectures, and to be accessed by students for use as a resource for the papers they were required to write and illustrate, and for studying for exams.

Started in 1995-96, I continued building a digital image library in 1997-99 through my participation in a USDA National Education Challenge Grant project that included construction of an on-line slide library for holding and retrieving teaching slides for landscape subjects. The slides for the Landscape Architecture Image Resource (LAIR)* were contributed by faculty from the six American universities included in the research project (U. of Maryland, U. of California - Davis, U of Oregon, U. of Georgia, Cornell and Virginia Tech. at Blacksburg).

The image library built by this consortium has greatly increased individual faculty member's access to current and historic images of places they are likely to use in lectures. It has also provided an important resource for students and practitioners of landscape architecture as well. The library, served from the University of Maryland computer, has a custom CGI and search engine that allows any Boolean combination of the fields and keywords in the database to be used as search criteria. A table of labeled thumb nail index images is returned in a search, and information about each slide is available in summary or long form. These images can be accessed in real time or downloaded onto the instructor's hard disk for sequencing and playback in the lecture hall. For student access, the professor merely posts a list of URLs for the students to review or they can access images from their own computers or at school using the one-line search engine.

Though not as dynamic or explanatory as 3-dimensional animations, the capabilities of the on-line slide library offers a different kind of informational depth, and it's inherent flexibility and speed, compared to animated media, makes it the core of an effective and adaptable system of content delivery. Slide show software such as Power Point™, Director™ GoLive™ or Flash™ can provide easy assembly of sequences, complete with timing, titles and sound tracts for live delivery, CD ROM, DVD or distribution on the web.

Student Evaluations

During this project several successive years of student evaluations provided continual direction and feedback and revealed a high level of consensus concerning the educational value of our experiments. Moreover, in open-ended comments the students expressed enthusiastic support for our efforts and a expressed a desire to see more.

Because of student feedback, a sound tract was added to the tutorial and a Spanish version is planned for future production. I found that learning to create sound tracts is almost as obscure and deep as learning 3-D graphics, but in the end, we were able to record, mix and synchronize sound to add another dimension to the information offered in the tutorials. Again, we used affordable software to create the soundtracks, relying on SoundEdit 16™ on the Mac and Sound Forge™ on the PC.

Multimedia technologies are a moving target, with current capabilities exceeding my wildest dreams of just four years ago. My work has proven to me that it is not only possible but also practical to provide 3-D animations and interactive web-delivered media to students in a variety of formats, to enhance and augment their classroom learning. Their course evaluations provide a distinct picture of their enthusiasm, acceptance and perception of learning effectiveness of these beginning efforts. As always, the trick is to firmly establish the content and pedagogy and match the software tools and hardware to ones skill level and budget.

* See: http://www.LAIR.umd.edu for access to the LAIR on-line image data base

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A Conceptual Model For Utilizing The Internet For Social Development Research In Third World Countries

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Abstract: The vast inequity between info-rich and info-poor countries in the creation and dissemination of knowledge using technology is increasing by the minute. This paper looks at some issues that confront us as academicians in the sharing of info-wealth with colleagues in developing countries. It provides a model to create world wide web pages to facilitate the growth of professions.

1. Introduction

This paper describes a conceptual model to be adopted by various helping professions in creating relevant world wide web sites which will help bridge the divide between info-rich and info-poor nations. It looks at the area of information dissemination using communication technologies, with specific reference to the utilization of the Internet. One of the major needs for practitioners and researchers in the developing world is to have easy and cost effective access to educational material. Given the prohibitive costs in getting journals and books in their countries, these professionals are often struggling to get much needed information to improve the lives of the people they are dealing with.

We are entering the new millennium in the midst of an historical transformation wherein traditional communication mediums are being replaced by the products of the seemingly unstoppable digital revolution. The latter part of this century has opened the floodgates, and with that the unending possibilities, in the utilization of new information and communication technologies. Living through these changes, we are often challenged by opposing viewpoints on the social impacts of the technology revolution (Castells, 1998).

2. Background

The proponents of the new mediums hail all development as answers for the milieu of problems that exist in today's society. In their opinion, advances made in the digital age will benefit millions of people, through the early dissemination of information to prevent catastrophes, or simply just making one's jobs easier to handle. On the other hand, those opposing the unfettered growth of the new medium view these changes in disdain. For them, "information technology is a tool for renewed exploitation, destruction of jobs, environmental degradation, and invasion of privacy" (Castells, 1998, p.2).

The social contexts within which new information and communication technologies are developed need to be understood more fully. According to Castells, "social development today is determined by the ability to establish synergistic interaction between technological innovation and human values ... in a new model of development that could be socially and environmentally sustainable" (p.2). Just the development of technology will not solve social problems but its availability and use are a pre-requisite for the economic and social development in our world (Dosi et al, 1988; Hirst & Thompson, 1992).

This area is new to the area of social development. It is only recently that the United Nations has recognized the need to assess and develop appropriate technology for use in the area of sustainable development. With the creation of a program in Information Technologies for Social Development within the United Nations Research Institute for Social Development, it hopes to respond to the need for multidisciplinary research and international networking in order to identify appropriate strategies for the adaptation of new technologies in developing counties and countries in transition (Uimonen, 1997).

3. Pages of the Profession (POP)

While the majority of strides being seen in the development of web sites currently dwell in the area of e-commerce, the relative under development in the area of educational sites are alarming. Yes, there are sites stemming out of various universities and research centers which focus their attention in "selling" their product, namely a course or a program, the creation of pure educational sites are often frowned upon since there is no money to be made, especially in the area of the helping professions.

The POP model strives to provide a balance in both the creation of effective one-stop-site for the helping professions and at the same time generate money for the expansion of such endeavors. The model is envisaged as a constellation of sites dealing with the helping professions all with their own unique domain names, like socialworkeducation.com, nursingeducation.com, socialdevelopmenteducation.com, and so on.

To describe one such site's content, lets look at socialworkeducation.com. The site will be organized using the professions major fields of study, which includes Human behavior, Practice, Field education, Policy, and Research. Under each hierarchy there will be links developed to help the surfer to get all the information one needs to help understand the profession. It will also have additional categories for jobs in the profession, chat rooms for discussing issues, syllabi for various courses, e-journals etc,. In short, it will be a unique source of information for every college of social work in the country and abroad to use as part of their distance education program.

The financial aspects of such a site will depend on banner advertisements sold to universities, book publishers and others related to the field, like hospitals, agencies and so on. This will prove to be an effective medium of advertising since they have a captive audience in those interested in that particular profession.

4. Conclusions

The POP model will be an interesting blend of education and commerce which the distance education community will be quick to embrace. It will break the barriers of communication across world boundaries and will be in a position to share the experience of learning with all in question.

5. References

Castells, M. (1998). Information technology, globalization, and social development [On-line as of January 25, 1999]. Available: http://www.unrisd.org/infotech/conferen/castelp1.htm.

Dosi, G. et al., (1988). Technical change and economic theory. London: Pinter.

Hirst, P., & Thompson, G. (1996). Globalization in question. Cambridge: Polity Press.

Uimonen, P. (1997). Assessing the social development needs of the digital future. [On-line as of January 25, 1999]. Available: http://www.unrisd.org/infotech/publicat/future.htm

Wireless Digital Vehicle Mapping and Tracking System

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1. Abstract

This paper describes an experimental Java client-server system using the Amateur Radio Service over the World Wide Web (WWW). This system allows a mobile user to receive maps of his present location as well as send and receive messages to a user located at a central headquarters. Location information of the mobile user is obtained via a Global Positioning System (GPS) receiver and sent to the central headquarters by way of amateur radio. The server operator at the central headquarters is able to locate any mobile user at any given time as well as communicate with him/her. The software includes a Java client application and a Java server application. The client machine is an Intel based laptop running RedHat Linux 5.3. The server machine is an Intel based system running RedHat Linux 5.2 acting as both an Intranet server and an Internet gateway for the laptop.

2. Introduction

As our society evolves into a state of connectivity, TCP/IP and Internet access becomes as important in mobile situations as it does in the business community. The ability to send and receive feedback from workers as well as monitoring their productivity is a powerful tool for managers in the corporate world. This project extends wireless TCP/IP to vehicles providing services such as data communications and mapping systems based upon conventional networking technologies.

3.1 Client Services

The client user interface to the Wireless Digital Vehicle Mapping and Tracking System is a Java application made up of a mapping display which references the United States Bureau of the Census's Tiger Mapping Service. This provides both clients and the server with data of the vehicle's current position. The system provides two data frames: the first for intranet communications with the server and the second for displaying GPS data.

When the Java application is loaded, the data frames and the map image frame are instantiated and placed onto the desktop. The vehicle operator then supplies a username and password to gain access to the application's functionality and to identify him to the central server. After the operator has logged in, a socket is created between the client computer and the server computer and the input stream and print stream are obtained.

Once the data streams are obtained from the socket, the client receives a National Marine Electronics Association (NMEA) protocol string from the GPS receiver at a rate of one per second. The NMEA string that is received is of the form:

$GPGLL, 40.10000,N, 76.35700,W

where "$GPGLL" defines the specific protocol of the string, "40.10000" defines the latitude position, "N" defines the latitude position, "76.35700" defines the longitude, and "W" defines the longitude position. This string is then parsed, and the latitude and longitude are sent in the form of an IP packet to the server computer via the socket (and Amateur Radio Service). The client computer then downloads a Tiger map from the Internet and displays it in the map image frame.

The client Java application is also capable of sending and receiving lines of text via a dedicated socket service. This capability allows the server computer to communicate with the client computer and visa versa. When an operator pulls over to the side of the road, he is able to enter, via one of the data frames, text that is sent to the server computer as an IP packet via the socket (and Amateur Radio Service). The server computer can reciprocate this communication. When the server operator sends a text message, each client gets the message; however, the clients filter the message and only the client to whom the message is directed receives it. When the client computer receives the server computer's text message, the Linux computer is capable of speaking the text message. This allows the vehicle operator to receive messages from the server computer without having to look at the computer screen, thus making it safer for the vehicle operator to receive the message.

3.2 Server Daemons

The Wireless Digital Vehicle Mapping and Tracking System server software coordinates all aspects of the networked system. The server accepts connections from the Java client to receive position data, to send Tiger map images, to send and receive text messages, and send commands to the hardware. The server also maintains a database of client computer identification numbers and operator identification numbers.

The Digital Vehicle Mapping and Tracking System server displays a Tiger map image similar to that of the client. The server also displays a non-editable data frame that includes an identifier for each vehicle operator, allowing the central coordinating server operator to select a vehicle operator and view his/her location. Another data frame is also visible to the server operator for communication with any or all of the vehicle operators.

A position daemon is responsible for accepting connections from the client computer and creating sockets. The daemon then receives latitudes and longitudes in the form of IP packets that it uses to retrieve Tiger map images from the WWW. The Tiger map images are displayed on the server computer so that the server operator can track the path of the vehicle operators.

The communication daemon is responsible for sending and receiving text messages. The server operator selects the vehicle operator to whom he wishes to send a message. The server operator then types the message, which is then sent through the socket (and the Amateur Radio Service) to the client computer. Any message sent to the server computer appears preceded by the message originator's identification number.

4. Data Communications Infrastructure

The goal of the data infrastructure was to be as transparent as possible, yet emulate a system that could be used in a commercial environment. Careful planning led to the use of a TCP/IP-based system over packet radio in the Amateur Radio Service.

The network server consists of an Intel computer running RedHat Linux 5.2, kernel version 2.2.1. Linux includes Amateur radio support—including AX.25 and KISS protocol support—in the kernel, making it an ideal operating system to act as a bridge between the Internet, intranet, and the remote clients operating via radio.

Both client and server machines are connected to their own dedicated Terminal Node Controller (TNC). The TNC acts as a modulator/demodulator bridging the RS-232 ports on the server and clients to the radio transceivers. Each computer uses a series of protocol layers to allow TCP/IP to operate over the TNCs. The KISS protocol is the first protocol layer, allowing the computers to control the functions of their TNCs.

The second protocol layer of our setup is AX.25. The AX.25 protocol is similar to the more common X.25 protocol layer; however, it adds some features to make it more suitable for amateur radio. The AX.25 layer operates transparently to the user, and requires no additional attention other than being compiled into the kernel.

The AX.25 and KISS software allows the operating system to view the TNC as another network device. Thus on client machines, the TNC becomes the gateway to both the intranet and also the Internet. On the server, the TNC device is set up as a network, on the 192.168.1.0 subnet. Internet access on client machines is done using IP forwarding, masquerading, and firewalling on the server.

Since the system acts as any other broadcast network, multiple clients can share one radio frequency. In the case of collisions, a random backoff algorithm is used to time retransmission of the packets. Thus, companies implementing a system like this can purchase one frequency for multiple clients, and expand only when congestion occurs on that frequency.

Due to the transparency of the physical network layer in this system, network client applications act completely normal and need no modification. This allows web browsers, telnet clients, and future TCP/IP-based software to operate on this system, unless locked out at the server's firewall.

To reduce development time, Java applications for our system were developed in the lab on a 10baseT network. After the applications were finished, they were moved to the wireless system where they were executed in the same manner as in the lab.

5. Future Work

Although this project is complete, additional features could be included. Currently, when the client or server application is started, three frames appear on the screen. These frames should appear in the same window, allowing for better organization on the desktop. Another feature would designate different colors for different messages in the chat window. One color could denote a message from the server that is intended solely for the client, another could denote a broadcast message from the server to all clients, and another could denote a message that was sent by the client.

Additional features could also be added to the mapping system. One feature would be to include client identification numbers on the maps of the server computer. This would allow the server operator to view the position of several vehicle operators at the same time. Another feature would allow the server operator to choose from various mapping systems.

With today's computers getting smaller in size, this system could be made into a solid-state machine. The recommended hardware for this could be developed using a PC/104 based system along with a PC/104 based GPS card. This would reduce the size of the system to 3 ½ x 3 ½ x 3 ½ inches (H x W x D).

6. Conclusion

This paper describes the Wireless Digital Vehicle Mapping and Tracking System. This system uses a TCP/IP network foundation to allow mobile clients to access an intranet and the Internet in the same exact manner as accessing these networks in a conventional fashion. This allowed us to develop our network applications and run conventional client application with no special modifications for wireless use. Server operators are able to track drivers precisely and effortlessly. More information can be found at the Wireless Digital Vehicle Mapping and Tracking System page, http://wireless.millersv.edu.

7. References

Flanagan, David, "Java in a Nutshell," First Edition (JDK 1.0), O'Reilly Press, Sebastopol, CA, 1996.

Flanagan, David, "Java in a Nutshell," Second Edition (JDK 1.1), O'Reilly Press, Sebastopol, CA, 1997.

Geary, David M., "Graphic Java 1.1 – Mastering the AWT," Second Edition, Sun Microsystems Press, Mountain View, CA, 1997.

Oaks, Scott, and Henry Wong, "Java Threads," O'Reilly Press, Sebastopol, CA, 1997.

Privacy, the Workplace and the Internet

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Abstract: employees do not lose all rights to privacy with respect to their employers by virtue of being employees. This paper considers various arguments for the surveillance and monitoring of employees, including both those that look at the benefits or supposed benefits to the employees themselves and to the employers. It is shown that most of these arguments do not have much force.

The existence of the right to privacy, and related rights such as confidentiality and autonomy, is sufficient to undermine extreme views such as the view that employees ought to be under surveillance every minute of the working day, or that should they be in a situation where they suspect that they might be under surveillance all day, or that there should there be surveillance of a nature or extent in respect of which the employees are ignorant. These extreme situations involve unjustified invasions of privacy. Employers have certain rights in respect of their employees, but there is no general and absolute right to monitor and control employees. To what extent can an employer justifiably infringe an employee's right to privacy. There is a right to privacy, and, other things being equal, employees have this right. The violation of the employee's right to privacy of concern in this paper, is that posed by the electronic surveillance and monitoring of an employee's activities made easy by current computer technology, particularly networking. Keystrokes can be monitored for speed and accuracy, and the work on your screen may be brought up on the screen of another without your knowledge. Common software for accessing the Internet logs all activity, so that a record is kept of all visits to all sites, and email, listservers and so on can monitored.

Employees, as well as having at least a prima facie right to privacy, are also accountable their employers because their employers have a right to a reasonable extent and quality of work output for the wages and salaries that they pay, and it is in the employees' interests (as well as the interests of employers) that their employers make a profit. Given potential conflict between these rights, perhaps an employees' right to privacy, *qua* employee, can, in a range of circumstances, be overridden.

The claim is that computer monitoring of employees has multiple benefits, at least potentially. It improves the quality of goods and services, and so is good for customers; it makes businesses more efficient, so profits rise, which benefits employers; and it helps employees get higher pay and promotion, and assists them in doing their jobs better. Given all these benefits, why is it questioned? There are two types of reasons, one type based on the unacceptable consequences to the organisation of monitoring and surveillance. Such consequences include ill health, stress and lowering of morale. The other type of reason concerns the harm to employees, including as a harm, infringement of employees' rights to privacy. Other harms relate to employees' well-being. There is evidence that computer monitored employees suffer health, stress and morale problems to a higher degree than other employees. If it does indeed generate these sorts of problems, then these problems must be weighed against the benefits. It might be countered that if the problems are too great, then monitoring will not make organisations more efficient, and so the practice will stop. Alternatively, the organisations who practice it will not be able to attract good employees, and so will be forced to discontinue it. One weakness of this counter is that workers are not always free to pick and choose their employers, particularly in times and places of high unemployment. Many will almost certainly prefer to work under conditions which they do not like, than to not work at all. Another flaw is that it is not necessarily true that practices which are detrimental to health and morale will lead to less efficiency, at least not in the short term. For example, forcing workers to work for long hours without rest over extended periods could increase productivity in the short term, but lead to longer term health problems. Raising the levels of stress through continual monitoring could have the same effect. If the work requires a relatively low level of skill, and if there is unemployment, workers are easily replaceable. If the motive is short term profitability, long term effects are irrelevant. More importantly, treating workers in this fashion may be good for the profitability, long and short term, of that particular business. The problem may be the long term ill effects on the business sector in general, or on the specific industry sector in question.

The moral objection to computer monitoring is based on the principle that a right cannot be infringed without very good reason. It would be rare that greater efficiency or profitability would constitute such a good reason. There clearly are times when a person's privacy rights can be overridden. An unconscious and unconsenting hospital patient, for example, may need constant monitoring, but that is for the patient's own good. A prison inmate might also need constant monitoring, but that might be for the protection of the community. Monitoring of employees however, does not, in most circumstances, secure these fundamental rights to life and protection.

A defender of computer monitoring might argue that the moral problem only arises if employees have no input into the establishing of the monitoring system, or if they are not fully aware of its scope and implications. If these conditions are satisfied, there is no moral problem, because the employee has, in effect, consented to the system's use, by accepting employment under those conditions.

While this has some initial attraction, on closer examination it is not so plausible. When unemployment is high, or if the person badly needs a job, there is not much force in consent. It is rather a case of economic coercion. A second problem is that even if people do consent to some sort of treatment, it does not follow that it is moral to treat them in that manner. Slavery cannot be justified on the grounds that some slaves may not have minded their condition too much if they knew nothing better. Likewise, violation of privacy cannot be condoned simply because some employees are willing to accept it.

What can be made of the argument that employee monitoring can be to the benefit of the employees themselves. Their privacy is violated, but it is in a good cause. Three benefits to the employee have been suggested. One is that it can, if used properly, help them to improve their work practices. This might be true, but it would at best only justify short term monitoring, and only with the employee's consent. Perhaps the techniques and satisfaction of clumsy lovers could be improved by information gained from spying on their activities, but that hardly seems to justify spying. A second benefit is said to be that employees can be assessed on purely objective criteria, say number and accuracy of keystrokes. While objectivity is good, assessment of an employee's worth will usually have a substantial subjective element as well. A highly responsible or experienced person who types slowly may well improve the productivity of others. So at best this is a weak justification for infringement of privacy. Finally, it is argued that this monitoring will help get rid of 'dead wood', workers who are not doing their fair share of the work. This will not only be good for the employer, but also for the other employees. However, while none of us want to support lazy and incompetent colleagues, it is not clear that this will not have countervailing effects, namely, on the hardworking and competent workers also thus monitored. There could, of course, be limited and targeted monitoring where there was good reason to believe that particular employees were not meeting reasonable standards. This would seem to be a far more reasonable policy. However this is clearly not *general* monitoring and surveillance of the kind being discussed here. Supporting such colleagues is not good, but violation of privacy would, to many, seem even worse.

A stronger argument for employing surveillance is the control of crime in the workplace, especially theft and financial fraud. Victims of crime have moral rights which sometimes override privacy rights. Theft and fraud in the workplace are still theft and fraud, so some surveillance can be justified in order to apprehend culprits.

What about monitoring employees' email? While this might be thought to be akin to opening private mail or listening in to private conversations, the argument is that because the system on which the email operates is owned by the employers, they have a right to read any messages. But do they? The fact that two people are conversing in my house does not give me an automatic right to listen to what they are saying. But what if the two people are my employees? Does this make a difference? One argument that it does not, might go as follows: All I am paying for is my employees' labour. What they say to customers might be my business, but what they say to each other is not if it does not obviously and directly harm the business. Perhaps the cases are not analogous, because in the email case they are using my equipment, while in the other they are not. But what they say is still none of my business even if the consequences of what they say might be. The fact that they are continually having conversations might be overloading the equipment or hindering the work of others or themselves. Accordingly, banning or limiting private conversations might be justified. But this would not justify *monitoring* conversations. Does this miss the point? How will I know if the email is being used for private discussions unless I monitor it? I will not know unless I am told. But if no problems are being caused by overuse and so on, then there is no need to worry. If no harm is being caused by personal email, either to the computing equipment or to productivity, then monitoring what is said can have no purpose, except perhaps to satisfy curiosity. This is hardly a justification for violating a right. There could be a limit put on the length or number of messages, or the productivity of employees in question could be investigated. Employing people does not confer the right to monitor their private conversations, whether those conversations be in person or via email, even if they are work related.

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GUI for Geometric Inference Engine on Internet

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Abstract: We are developing a geometric inference system on Internet. A rough geometric figure drawn by a student is transformed into an ideal one that satisfies the assumptions. The system extracts particular patterns in this figure and tries to connect the assumptions and the conclusion. The present paper extends the visualization of the proof by introducing a multiple view which consists of (a) sentence view (b) inference tree view and (c) figure view. The sentence view gives a proof written in usual sentence. The inference tree view shows a diagrammatic inference tree whose leaves are assumptions and whose root is the conclusion. Each pattern has three appearances in the multiple view. And they are related to each other. When the student clicks a pattern in one view, the counter parts are highlighted simultaneously in other view. With this system, students can learn geometric inference visually and interactively.

1. Introduction

Geometric Inference systems have been studied since early days of computer history. Those systems used character-based user interface. So they were not easy for students. Recently, some systems, e.g. Gex [Chou 1996], have a graphic user interface. But most systems use only literal expressions to show the result of the inference. These system are difficult to understand the proof as a result of inference. As we know, figures are more intuitive than words. There should be suitable forms for showing a proof of geometric inference. We are developing a geometric inference system SK. Main feature of SK is its GUI and availability on Internet. Anyone can use the system directly at http://matu.cc.kyushu-u.ac.jp/~mishima/sk-e/.

2. Overview of the system

SK is a geometric inference system on Internet. The system consists of 4 components:

(1) GUI to draw figures and express hypothesis and conclusion,
(2) a numeric engine to transform a rough drawn figure into a precise figure which satisfies the hypothesis,
(3) a geometric inference engine, and
(4) proof visualizations.

The geometric inference engine adopts Koedinger's DC-model method [Koedinger1987,Suwa1995]. This method is one approach from the cognitive science to overcome the explosion of search space. A DC-model represents a prototypical geometric image. The method needs a precisely drawn figure to detect such patterns. Those patterns are used to guide the inference process. The GUI components are implemented as Java applets and the engines are implemented in Lisp. The four components are integrated on Internet with a server/client model.

Students draw a geometric figure and specify the hypothesis and the conclusion simply by clicking and dragging their mouse [Fig. 1]. The system considers the hypothesis as constraints and transforms them into equations. The numeric engine solves the equation by approximation. An ideal figure is obtained as a solution.

The geometric inference engine makes an inference. When the system succeeds to prove, the proof is displayed as a sentence and as a inference tree.

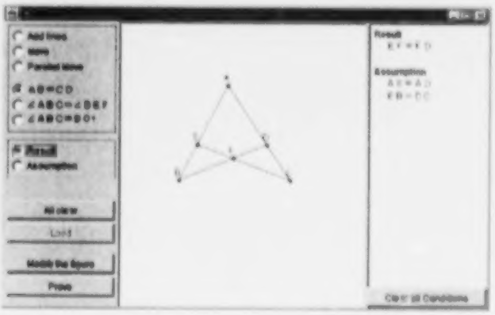
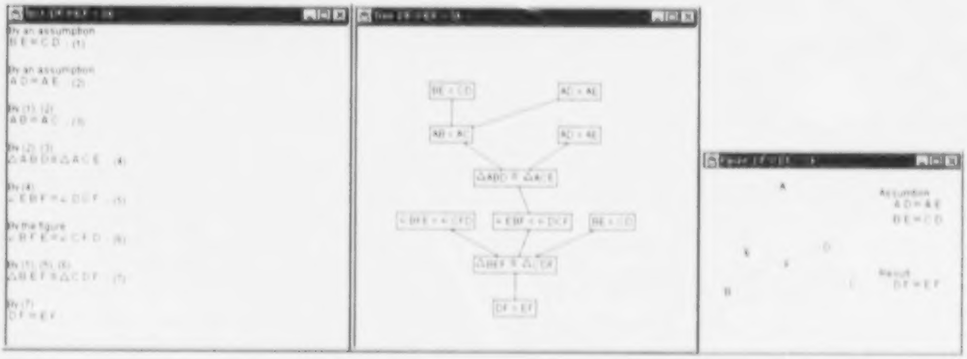

Add lines
Parallel lines
AB=CD
∠ABC=∠DEF
Result
Assumption
All clear
Load
Modify the figure
Prove
Result
EF=FD
Assumption
AE=AD
EB=DC
Clear all Conditions

Figure 1:Figure drawing on SK

3. Multiple view of the inference

The proof visualization is realized by introducing a multiple view which consists of (a) sentence view, (b) inference tree view, and (c) figure view [Fig. 2]. The sentence view gives the proof written in usual sentence. The inference tree view shows a diagrammatic inference tree. The leaves of the tree are assumptions. Each pattern is highlighted in the figure view when the counter part is specified in the tree view or the sentence view. In this way, when the user clicks a component in one view, the component in other views is highlighted simultaneously.



By an assumption
BE=CD (1)

By an assumption
AD=AE (2)

By (1),(2)
AB=AC (3)

By (2),(3)
△ABD≡△ACE (4)

By (4)
∠EBF=∠DCF (5)

By the figure
∠BFE=∠CFD (6)

By (1),(5),(6)
△BEF≡△CDF (7)

By (7)
DF=EF

BE=CD
AD=AE
AB=AC
AD=AE
△ABD≡△ACE
∠BFE=∠CFD
∠EBF=∠DCF
BE=CD
△BEF≡△CDF
DF=EF
A
E
D
F
B
C
Assumption
AD=AE
BE=CD
Result
DF=EF

(a) sentence view (b) inference tree view (c) figure view

Figure 2: Multiple view for geometric inference

References

S. Chou, X Gao, J. Zhang (1996), An Introduction to Geometry Expert, LNCS 1104, 235--239

K. Koedinger,J. Anderson (1987), Abstract Planning and Perceptual Chunks, Elements of Expertise in Geometry, Cognitive Science 11, 65--99

M. Suwa, H. Motoda (1995), Operator Schemata Acquisition based on Recognition Propagation Rule (in Japanese), J. Japanese Cognitive Science 2(4), 39--55

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Internet Customized Teaching/Learning Environments

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Abstract: The educational sector, while inclined to conservatism, has been active in its attempts to understand the impact of technology on teaching and learning approaches. The Internet design described in this paper places students at the epicenter of their learning experience in consultation with teacher-facilitators. It places a premium on innovation (creativity) in the making of coherent plans for action within culturally rich environments. The Internet is viewed as a huge physico-digital world in which student engagement, participation, initiative, and creativity are the foundational premises of a wholesome pedagogy.

Within educational institutions (and for that matter in the world at large), we are currently grappling with the need for major changes in approach as to how we conduct education and our lives. This is already apparent in e-commerce and e-trading now taking place on the Internet at levels that would have been unthinkable at the inception of the WWW some six years ago. We are standing at a continental divide the outcome of which we are unable to predict with any degree of certainty. There seems to be little doubt that computers and the Internet will eventually fin their way into every home (living center) on the planet. That being the case, it behooves us to insure its fullest possible introduction into the educational process beginning with the earliest years of tutoring and proceeding to the highest levels of learning.

The educational sector, although inclined to conservatism, has been extremely active in its attempts to understand the impact of technology on teaching and learning approaches and has already proposed innovative and perhaps more effective approaches than have been used in the past. Various models are being developed around the world, all to some extent expressing the individual insights of educators and developers as they ask fundamental questions such as:

- Are customized web environments a good idea?
- What types of activity are possible on the Web with regards to language learning?
- What learning/teaching styles can the Web support. Will learners experience more freedom in explorative mode or will it be expository at best and rigorously regimented at its worst leaving learner curiosity and inventiveness curtailed and teachers firmly in control?
- What kinds of learners and instructors are likely to benefit from customized environments?

SALAMA--the acronym for the Stanford African Language and Multimedia Applications site--is, in fact, a digital arena using the World Wide Web (http://www.aramati.com/salama.html). The Word SALAMA in Swahili means 'peace'. This new site pioneers the idea of a customized browsing environment for learning and teaching. SALAMA was created with the conviction that learning autonomy and teacher-facilitation are co-valued and optimal states in the learning arena. The Internet is viewed as a large physico-digital world in which student engagement, participation, initiative, and creativity must be nurtured. These qualities are the foundational premises of an effective pedagogy.

SALAMA is an arena enabling bi-modal search and includes enlightened exchanges between individual learners. It encompasses the access to information and the exchange of ideas in a style allowing learners to call on their individual talents and ingenuity in the process of learning a language. Bi-modality refers to two initial concepts: GUIDED browsing and FREE browsing. Learners are encouraged to select either one. The GUIDED browsing approach is recommended for complete beginners and requires teacher facilitation and suggestions while FREE browsing leaves all decisions to the learner (thus including the sophisticated user). Within SALAMA unrestricted asequential movement in a multi-directional web setting is governed by the learner's search for areas consonant with her/his unique learning pace [Mugane 1997].

As a learning arena, the SALAMA site offers numerous features promoting the use of technology towards humanistic ends. These include:

- Seamless interface with the internet both at local and world-wide levels.
- Access to resources---Internet and other--as a first step in implementing project-oriented action.

- Exploration of content in such a way that learners become involved in comprehending, manipulating, and interacting in the focus language, attending mainly to meaning rather than form [Moeller, 1997:8] exploring the modalities of discourse as it is applied to the real world.
- Provision for shifting the role of teacher to that of facilitator.

The vast materials within SALAMA site include:

- State of the art resources from other African language teaching centers (significant among these are video-clips from the University of Georgia.
- Leading scholars in African linguistics and language teaching and learning for pedagogical consultants.
- Customized environments making it possible for language professionals to judge for themselves what constitutes optimal learning sites and materials.

As pointed out by Levy [1997:30], what is important is to "shift from a naive search of a superior teaching machine to a more atomistic study of the characteristics of new media in relation to key factors associated with learning, the learner, and the learning context". It is the complex of the language learning process coupled with learner individuality and the arena in which thoughts develop that prompts the need for customization. Used instrumentally, the Internet will provide useful insights into how learning evolves when learners discover the importance of being in partnership with others--including distanced learning partners--and in constant touch with information resources. That learning can be perpetually taking place anywhere as long as there is a networked infrastructure helps learners to manage appropriately the navigational cost of time. The Internet has in fact cancelled the notion of distance and seriously undermined the primary importance of locus of activity.

Customized environments such as the SALAMA site are arenas in which learner autonomy (e.g., self-pacing, supportive instructors and the interactions with other learners (social dimension) can be maximized while maintaining the focus on relevant material. Customized environments deal with the all-too-familiar problem inherent in Internet design: scattered information (the link-labyrinth phenomenon). In addition, categories being sought often lead to larger and more general categories the quality of which varies considerably. One must even view the content of the Web as falling short of total accuracy. There is no GENERAL WEB EDITOR or system of assuring quality control and exactitude.

The SALAMA site--specifically the guided browsing section--is a place where learners can always return and seek clarification, continuity, and even evaluate their own progress relative to a significantly broad instructional base. In proposing a course of Swahili instruction, SALAMA is dealing with certain vexing issues concerning Internet design mentioned above. It is also proposing that students be at the epicenter of their learning experience and work in consultation with a teacher-facilitator. It places a premium on innovation (creativity) in the making of coherent plans for action within a culturally rich environment. Iterative and incremental in nature, learning takes place both in the classroom and the world beyond it thanks to the Web's technological infrastructure. SALAMA shares with all other Web sites, the infinite possibility for expansion. In this respect the site becomes a place where the efforts of learners as well as those of teacher-developers can contribute to the ever-expanding resources available for African languages and Culture.

In keeping our eyes focused on the meaning and mediation of learning, we provide our students an ideal opportunity to foster the acquisition of languages--no longer viewed exclusively as a content matter but as means to an end: the appropriation of linguistic know-how for expressing one's individuality and a spirit of world-collaboration.

References

Levy, M. (1997). *Computer-Ass[illegible]d Language Learning; Context and Conceptualization*. Oxford, Oxford University Press.

Moeller, A. (1997). "Moving from Instruction to Learning with Technology: Where's the Content?" *CALICO* Journal 14, 5-13.

Mugane, J. (1997). Learning African Languages with Evolving Digital Technologies. *Africa Today* 44 (4), 423-442.

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A Web-Based Interactive Shared Journal System

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Abstract: The Web-Based Interactive Shared Journal System (WISJS) is a tool that was created at the Center for Technology Innovations in Education to facilitate learning from field experiences by providing students with the capability of creating media rich journal entries that can be shared with mentors and other students. Journal documents are created, edited and shared using a web browser. The system is being used in a variety of test-bed learning communities including teacher education students engaged in field experiences, high schools mathematics and science students engaged in project-based learning, and library science students engaged in practicum.

Internet-based tools, such as *Web Course in a Box* and *WebCT* are rapidly increasing access to distance teaching through cyber courses. Web pages of support materials, listserves and bulletin boards of threaded discussions often extend and enhance what heretofore had been accomplished in classroom settings. Distance teaching and classroom teaching each have strengths and weaknesses that must be considered when selecting a format for instruction. For example, working through a problem or providing a complex explanation for why a student's work is insufficient is often more easily mediated face to face than via chat or asynchronous messages. However, asynchronous and distance approaches often allow more students to participate in discussions, and reviewing assignment materials or contributing to a discussion when you are ready at 10:00 pm rather than getting up for an 8:00 am class can be very attractive to students. Working through these trade-offs and either integrating distance teaching tools into classroom instruction or improving the implementation of distance teaching tools is receiving much attention.

The development of the Web-Based Interactive Shared Journal System (WISJS) has been an effort to facilitate learning from field experiences, a type of learning not well supported either in classroom or cyber courses. Field experiences are approaches to learning implemented in many professional development programs that emphasize apprenticeship and contextual learning. For example teachers do student-teaching, nurses and librarians have practicum experiences, and doctors and lawyers do internships. Other forms of apprenticeship learning are emerging in K-12 and higher education as projects and problem-based learning. Key to learning from field experience or from apprentice forms of education is the having and processing of experiences in legitimate settings of practice. Ideal learning systems will include support (1) for making sense of experiences and solving problem in situ, so that the learners is supported in taking on authentic challenges of the practice setting, and (2) for capturing and representing those experiences, so as to share with mentors and other students, as well as for later review and reflection.

The Web-Based Interactive Shared Journal System (WISJS) is a tool that can augment either classroom instruction or cyber courses by enabling students to easily capture and organize experiences in ways that allow rich-mediated representation and sharing across the Internet. WISJS is a client - server system that communicates over the Internet using TCP/IP connections. The client is implemented within a DHTML browser environment (using 4.0 Netscape or Internet Explorer). A custom server was created for connecting and maintaining a login between the client and server, and provides communication between the client and an Oracle database. WISJS is a re-implementation and advance of an earlier, Macintosh client based journal system (1998). WISJS has been designed to support four key processes of distributed learning: representation, guidance, feedback, and shared memory. These processes are undertaken in the context of a community made up of four roles:

- administrators, who are responsible for the system
- mentors, who are responsible for instruction and modeling
- students, who are responsible for articulation of experiences
- guests, who have limited access to public information

WISJS is being used with a variety of test-bed learning communities, including teacher education students, high school mathematics and science students linked to University students to support project-based learning, facilitation of practicum experiences for graduate students in Library Science, and graduate courses at the University. Another test-bed for the Journal system is to support team work and problem solving among children across the nation as they take on an authentic challenge (this project is supported by Motorola University for children of Motorola employees.)

Users have secure access into a community of learners through a login. A set of services is available to the user upon entering the community, including an inbox of recent activity, an ability to create documents, access to their documents, access to documents in the journals of other members of the community, mail and note services, and chat for synchronous communication. The News section of the window also serves to alert the user when new tasks, notes, or appends are relevant.

Users of WISJS can use a point and click approach to placing text, graphics, audio and video, and hyperlinks to URL's or other journal documents in their journal documents to articulate their experiences. Document creating and editing takes place in the browser using a web-based interface.

Mentors in WISJS can provide tasks to learners. A task is a journal document created by the mentor, converted from an ordinary journal entry into a task and then distributed through WISJS to the appropriate learners or teams of learners. A learner is notified of a task as part of the login. When the learner opens the task they see the instruction, assignment and support information provided by the mentor. The learner can then "edit" the document to complete the task or report on completion of the task. In the process of working toward task completion the learner can indicate through a pull-down menu their advancing status toward completion by setting task completion from 0 to 100%. The mentor can quickly review task completion by reviewing the distribution list for a task. A distribution list carries information about task completion status and allows direct access into the learner's task response. Tasks are a medium for providing guidance from a mentor to a learner. The progress status indicator saves time for the mentor and facilitates communication between mentor and learner.

Feedback is provided through appends that can be attached to journal documents so as to make a suggestion, reinforce the representation, ask a question, or establish a dialogue about the experience represented in the journal document. Appends allow other system users to provide feedback or commentary, in a sense establishing a discussion list or personal seminar, to journal representations. The database of experiences captured in each individual journal entry form a community memory of learning experiences. A system such as WISJS, which captures experiences, can grow dynamically. WISJS has potential to support learning from field experience by providing learners access to a shared memory of experiences, and by facilitating feedback and reflection upon the field-based experiences of the learners.

A Web-Based Homework Notification System

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Abstract: The Homework Notifier (HN) is a web-based system to facilitate communication and collaboration among the key parties about an important work effort of school, homework. HN is a prototype system designed and implemented in a test-bed school (Oakland Junior High School in Columbia, Missouri) to teach us how to electronically mediate and facilitate the processes of school to home communication around homework. Homework Notifier was developed at the Center for Technology Innovations in Education.

Educators and society have great hopes that information technology can contribute to school improvement. However, even the most optimistic technologist must admit that while computer and network technology continues to rapidly advance, little has changed in schooling except for increasing amounts of the budget being devoted to technology purchases and teacher training. After a review of the status of educational technology, The President's Committee of Advisors on Science and Technology [1] concluded that, "During a period in which technology has fundamentally transformed America's offices, factories, and retail establishments, however, its impact within our nation's classrooms has generally been quite modest." Curiously, business and industry were drawing similar conclusions, the productivity paradox, for their investments into information technology during the 1980's. Not until businesses revamped and improved processes toward flatter organizations, more responsiveness, and greater empowerment that took advantage of information technology did the benefits of technology start to show-up on the bottom-line. Key to many of these initiatives were the ideas of empowering people with information, synchronizing work teams, and building closer and more cooperative relationships with customers.

The Homework Notifier (HN) is a web-based system to facilitate communication and collaboration among the key parties about an important work effort of school, homework. HN is a prototype system designed and implemented in a test-bed school (Oakland Junior High School in Columbia, Missouri) to teach us how to electronically mediate and facilitate the processes of school to home communication around homework.

Homework provides an opportunity for children to take responsibility and work independently. Being consistent and thorough in doing homework can build good work habits for later schooling or work opportunities. Homework is also a chance to extend learning and practice skills and to use knowledge learned in school. Thus homework can contribute in a number of important ways to a child's education. Homework is also a place of great variability among students. The best students do homework thoroughly and consistently:

The poorest students may rarely complete their homework. Parents are often frustrated by an inability to know what is expected of their son or daughter and sometimes with an inability to help a students who is struggling with homework. Some students may be similarly frustrated when sitting down to do homework and realizing they do not have all the information they need to do their assignment or may need more help to successfully complete the assignment.

Homework Notifier was developed to provide direct communication to parents and students about homework assignments. Parents and students can log-in to Homework Notifier and easily see the assigned homework. Homework Notifier also makes it easy for a parent or child to send a note to the teacher. The parent or student access a URL through a browser. For our current test-bed of parents the most common access is through AOL. Using an ID and password the parent or student gains access to their account. From here the user can review assignments, access resources (such as, links to general homework support pages, etc.), seek specific help in using HN, or logout. Links are provided to the web page and email of the teacher. Within the body of this assignment the teacher can provide web links. Clicking on a link will open another browser window and access the appropriate URL. This feature allows the teacher to create mediated and well-supported assignments. The parent or student can also review previous assignments.

When a teacher logs into the system he or she has access to additional functionality for creating assignments, managing classes and groupings, as well as adding users at the student level. Within the assignments area teachers have the ability (1) to create new assignments, (2) to view, modify, or delete existing assignments, and (3) to manage the distribution of assignments to students.

Feedback from teachers, parents, and students indicate that HN is simple to use and provides an empowering feeling. Some parents who want to help their children by providing close supervision of school work see the system as enabling them to have the information they need to make decisions, e.g. can the child go to a movie or do they have unfinished homework. Other parents see potential for helping them help with homework. To the extent that links can be made to resources that provide explanation or backup information the parents can help with the process of bringing that information to bear on the assignment. The teacher feels that the system gives her another tool for working with parents and for extending her impact into the homework of the children. Similarly most students look favorably upon the system, because it can help them form falling behind if they are ill, and for having the right information for doing assignments.

We are in the early stages of implementing the test-bed and learning about facilitating the homework process, but it is easy to see ready benefits in building communication tools between the home and school that enable parents and teachers to work in partnership.

[1] The President's Committee of Advisors on Science and Technology. (1997). Report to the President on the use of technology to strengthen K-12 education in the United States page 6. Executive Office of the President of the United States.

THE INTERNET AS A RESEARCH TOOL: Cheers or Tears?

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Abstract: The purpose of this anecdotal study was to find out how well the Internet could serve as a tool in conducting research. While doing a regular research on gender issues among US and Japan female faculty in computer-related programs in higher education, a concurrent study of the use of the Internet in four research activities was carried out. These research activities were: development of research instrument, data collection, literature search, and search for survey participants. This report describes the procedures taken, and, the benefits (cheers) and difficulties (tears) that the use of the Internet brought to each research activity.

INTRODUCTION

Information literacy is broadly defined as the "ability to recognize when information is needed and the ability to locate, evaluate, communicate, and use it effectively" (Behrens, 1994). Of the various information technologies that have been developed recently, the Internet, in particular, has become an indispensable tool in the location, processing, and communication of information. The challenge to educators then is to better understand the Internet so it could be utilized more effectively as a research tool.

PURPOSE

This paper is an attempt to study the Internet as a research tool: what works and what does not work. It is a report about a concurrent anecdotal study of the Internet that was conducted while doing a regular research on gender issues among US and Japan female faculty in computer-related programs in higher education.

Research work, in general, consists of various phases: identifying a problem, reviewing related literature, formulating hypotheses, selecting subjects, developing data collection instrument, collecting data, analyzing data, and, interpreting and communicating results. With the advent of the Internet, some phases of research work began to take new approaches. For instance, when doing review of literature, an Internet search can help find online journals. While authorities continue to voice concerns about the quality of Internet materials, users are multiplying in numbers and online information is increasing in exponential proportions. Another recent use of the Internet is for online surveys. The assumption is that putting online surveys will reach more respondents and hopefully get more responses. Yet, to date, little is still known as to how the Internet fares as a research tool.

STUDY

This study selected four phases of research work and within each, conducted activities to find out how well the Internet worked as a research tool. These research phases, plus the benefits (cheers) and difficulties (tears) that the use of the Internet brought to each research phase are described briefly in the following sections.

A. Developing an Online Research Instrument. An online 90-item survey questionnaire was developed to collect data on factors that influence women representation in computer-related programs in higher education. The expectation was: an online questionnaire would facilitate the fielding of the survey, the analysis of responses from participants, as well as the statistical computations.

Cheers and Tears: The online survey successfully and automatically sent responses to a data input file, and then to a spreadsheet. (This session includes a quick demonstration of how the online survey was set-up.) It eliminated the time required to manually input responses from printed surveys. A perfect transfer of data from 90 items was made, where spreadsheet columns received the responses in the order they were sent (including items left blank). Except for two cases where respondents used a comma in their text response, the integrity of the data remained intact. By including the survey's website address in the email sent to participants, they were able to access the survey website easily. Feedback was also received immediately. When using the Internet for developing online surveys, a good HTML programmer, preferably a student assistant, is needed, as well as some budget to pay for programming time. There are also hardware and software requirements before an online survey can be developed.

B. Data Collection. Will the Internet be a better tool for collecting survey data? It was the expectation that the Internet survey (sent to 159 participants in US and Japan) would generate more responses than the print survey (sent to 184 participants) because of the ease and speed that are available to participants when answering and submitting the questionnaire.

Cheers and Tears: In the US, more print responses (40%) than email responses (22%) were received. In Japan, email responses were almost nil (3 out of 60) and print survey responses were 23%. The difference in responses could indicate that the Internet, compared to print surveys, may not be the better tool to use when collecting data.

C. Literature Search. Will websites used as online references still exist after a given time? Fifty (50) websites used as references in the gender research study were saved and then were accessed again after one year to find out if they still exist.

Cheers and Tears: Of the 50 websites used as references, only 12 websites could be accessed successfully after one year. Most of those that were not accessible had changes in their addresses or URL's. One website had a message that the link is "no longer working", while another website has turned commercial and requires access fee.

D. Search for Survey Participants. Is the Internet a good tool when looking for potential survey participants?

Cheers and Tears. Using the Internet, it was very easy to locate homepages of female faculty in computer-related programs. However, more time was spent in locating the addresses of their universities. Although university homepages had lots of information on academics and admissions, it was not uncommon that the address and main phone line of the university were not provided on the main homepage, requiring one to access links and sub-links before this basic information was found.

SUMMARY AND RECOMMENDATIONS

The benefits of using the Internet as a research tool include the ease and facility of transferring data from an online survey to a spreadsheet or statistical application. However, careful consideration is recommended when deciding between an online vs. printed version for data collection. The design of the online survey, the length of the website address, and users' trust of the Internet are possible factors that could affect the use of an online survey vs. a printed one. When using online materials as references for a research study, it is recommended that disk or hard copies of these websites are kept. Bibliographies that include online references may not be accurate and useful to readers after a year or so because website addresses undergo changes and become inaccessible. The Internet is also useful when locating faculty to be participants in a study, but this is not problem-free. Because of poor homepage designs, some websites do not include basic information such as complete addresses and phone numbers, thus requiring further searches. It is recommended that website designers include complete information for university, department, as well as individual faculty. Overall, the Internet can serve as an efficient tool for research, but just like other technologies, awareness of its strengths and weaknesses need to be considered carefully when used as research tool.

Reference:
Behrens, S. (1994). A Conceptual Analysis and Historical Overview of Information Literacy. College and Research Libraries, pp.309-332.

SIMULAB, Collaborative Tasks for Language Learning in the Web

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Abstract: With the support of the European Union, the SIMULAB consortium have developed a concept for Web-based collaborative tasks, mainly designed for language learning. A customized Web-based software, Telsi, has been created to cater for the needs of this type of international activity. This paper is an introduction to both the pedagogical concept and to the rationale behind the software and aims at presenting both the present and the future potential of SIMULAB.

SIMULAB and the simulation concept

One of the main and often most difficult tasks of language teaching is to create and implement methods that will motivate their students to use actively the target language, both orally and in written form, in a way that appears meaningful to them and therefore leads to real learning. The SIMULAB concept provides language teachers with such a method and it has the added values of integrating ICT into the learning process as well as connecting the classroom with the outside world and encouraging internationalization and collaborative learning.

SIMULAB is a concept that involves WWW-based communication between language students across national borders, around a specific problem or SIMULATION. The concept of simulation used in this pedagogical approach is based on the French "simulations globales", developed in the 70s and 80s. The term simulation is here used for an activity that is based on roleplay and involves the use of fictive identities for a negotiation between different groups that will try to solve a problem together. Paradoxically enough, the use of a fictive frame makes the communication more real. Pedagogic research has proved (Randall Davis, 1996) that "simulations provide a way of creating a rich communicative environment where students actively become a part of some real-world system and function according to predetermined roles as members of that group."

The TELSI software

The SIMULAB laboratory, based on the specially designed TELSI software, is an Internet-based tailor-made environment for role-play activities in language learning. The environment consists of a flexible system of authoring tools, which allows any language teacher to create simulations on the Internet for their pupils. This includes systems that give access to internal e-mail systems within a group; communication with others outside the SIMULAB environment; internal recordable "chat" forums in real-time; easy creation and editing of documents on-line and easy linking and hypertext creation.

The pedagogical frame

The main aim of the simulation activity is to stimulate the production of authentic, spontaneous oral language in classroom discussions and of written language in the communication with other groups through the WWW.

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All student groups (preferably not more than 3 or 4 in each simulation) are presented with a problem that has to be solved by the whole network. Each group gets a "group identity" that will differ from that of the other groups. Within each group the students will then have to choose and define their own personal identity, which will be identical with the role they play in the simulation. Since both the group's and the individual identities will be placed within the frame of the culture pertaining to the target language, students will be faced with the need to find relevant information about that culture. During this phase, most of the activities will be centred around discussions in class. Computer communication will be used only as a source of information.

Once the individual identities have been established, the students will start the communication with the other groups in the network, by introducing themselves in their new personalities. The second phase of the activity can then start: the students in each group will discuss among themselves what will be their first suggestion for a solution of the problem presented to the network. Once they have agreed on a strategy, they will communicate it to the other groups. On the basis of those suggestions negotiations can begin. Because the student groups have spent some time discussing the problem, they "own" , psychologically speaking, the suggestion that their group presents. The need for "fighting" for their solution, that will surely arise during the negotiation phase, will create the basis for real communication. The TELSI software, created by the SIMULAB project under the TELEMATICS in Education and Training programme, makes it possible for the teacher to structure and control the simulation process. The experience gathered in the validation phases of the mentioned projects shows that it is possible and desirable to use the simulation activity as a frame that can provide links for all the different disciplines contained in the process of language learning: comprehension, production, grammatical correctness, structure of discourse, etc.

SIMULAB as innovative method for language teaching and learning

The SIMULAB project has been awarded the European Label for Innovative Language Teaching and Learning 1998. The jury mentioned as background for their decision: „The SIMULAB concept creates international networks of student groups that will work together to accomplish the task indicated in the script. The simulation scripts can be adapted to different languages, themes, levels or specific language needs and can be used as soon as an elementary discussion is possible."

The future of SIMULAB

The future of the concept will to a large degree depend on the creation of networks between motivated teachers who are familiar with the concept and the use of the software. Experiences with the SIMULAB concept have shown that it is essential that the teacher understands and feels familiar with both the concept and the software before starting a simulation with his or her students. In recognition of this fact, the consortium are currently offering teachers from all over the world the free participation in "teacher simulations" in which they can learn about the SIMULAB concept, become acquainted with the TELSI software, have first-hand experience of the role play activity, and network with other language teachers

For more information about the project, please see http://oyt.oulu.fi/tsimulab

References:

-Journal references:

Davis, Randall. (1996) Simulations: A Tool for Testing „Virtual Reality" in the Language Classroom", in „*Curriculum and Evaluation*", The Japan Association for Language Teaching, Tokyo.

Structures and Tools of a Virtual Campus for Life-Long Learning

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Abstract: Rapid changing demands on the firms and employees within the field of information and communication technologies have forced Swiss universities and enterprises to set up a virtual campus for life-long learning. The presentation gives an overview of the organizational structures, the tools and methods, and the way of information sharing between teachers.

1. Introduction

The new information and communication technologies induce a fundamental change in contents and methods of the working process. A continuing educational system has to adapt rapidly to corresponding requirements. Some of the key words are learner-centered, problem-based, experiential, collaborative and interactive distance learning. Therefore we are setting up a virtual campus for post-graduate studies in information and communication technologies. Methods and tools relating to new learning technologies are elaborated within the project CLASSROOM 2000. The corresponding information, knowledge and experience is shared within a common workspace called HEURIS, an information system which is accessible through the Web.

2. Setting up a Virtual Campus

Rapid changing demands on the firms and employees within the field of information and communication technologies have forced Swiss universities and enterprises to set up a training partnership. The post-graduate studies called NDIT/FPIT (Nachdiplomausbildung in Informatik und Telekommunikation / Formation postgrade en Informatique et Télécommunications) is a successful example of a collaboration between universities and technology oriented industry. The partnership is organized according to the model of a virtual enterprise. Over 40 partner institutions contribute with standardized modular courses in their special domain. The compact courses are held all over Switzerland at the sites of the contributing partners. The target public are engineers and project managers in the field of computer science, business information systems, telecommunication and multimedia. Today about 160 students are enrolled in the post-graduate courses, and they assemble their individual curriculum from the modular program according to their professional needs. The partnership network is managed by a slim organization which elaborates the study concepts, specifies the curriculum and cares about the marketing and financing of this virtual university. The geographically distributed course providers, the collaborative organizational concept with modular courses and highly skilled and motivated students make this program an ideal test-bed for the implementation of new educational technologies.

3. Elaborating Tools and Methods

Two years ago we founded a consortium of institutes and firms working in the field of new educational technologies. The ongoing research and development activities are running under the name of CLASSROOM 2000 (cf. http://www.ndit.ch). Some of the main activities can be summarized as follows:

The MEDIT research project aims at developing a Web-based environment for a variety of pedagogical modes. For the design of this hypermedia authoring system a joint collaboration between different but complementary know-how is mandatory: computer science, telecommunications, human computer interaction, pedagogy etc. The originality lies on the use of highly structured documents which results in an efficient management of all document classes. For instance, from the same set of course documents, the system can provide a classical view (by chapter or by session), but also a new one, namely the semantic view. It allows a student to create and maintain his private working space. This does not only permit attaching annotations to an existing document, but also integrating course documents according to his way of learning.

For two years we have been running different prototype courses in a virtual classroom environment. We propose an intermediate tele-teaching form, which is based on the public telecommunication networks ISDN (Integrated Services Digital Network) and Internet. The students communicate among themselves and with their teachers by video telephony, e-mail, electronic blackboard, documentation service and forums. One main objective of the project is to set up a handbook for future implementations of the same kind.

An important aspect of the CLASSROOM 2000 project is the elaboration of pedagogical and didactical guidelines for teachers. We have to keep in mind that learning technology is about learning, it is not about technology! Given all the sophisticated multimedia, information and communication tools, it is tempting to use them without a thought about cognitive and social aspects. We have to think about new norms and rules of interaction. It is our goal not only to replace traditional educational technologies by new ones, but also to use them in a way that can improve our teaching results. Therefore we have set up an evaluation concept for a virtual classroom, which takes into consideration ergonomic, pedagogic, technological, social and economic aspects.

4. Sharing Information

During our activities within the CLASSROOM 2000 project and the NDIT/FPIT program we have become more and more aware that the specific information, knowledge and experience concerning the technical and didactical use of new learning technologies has to be shared in a common pool. For this purpose we have decided to develop an information system called HEURIS, which at the moment is available in a first version. It implements a push and pull approach, what means that users will not only benefit from the available knowledge, but they will also upload bits of their own information and experience.

The shared information can be characterized by four dimensions:

- Technology: HEURIS provides information concerning the technical aspects of a certain tool. It describes the main characteristics, gives an overview of the required infrastructure, discusses the time needed for installation and support, and offers pointers to some available products.
- Application: HEURIS gives not only technical but also practical advice. A view of the range of applications is crucial to the extent that a certain tool's potential concerning communication and knowledge transfer is no guarantee of its success. We often recognize a significant gap between the potential of a tool and the way it is really used.
- Didactics: A main goal of HEURIS is to bridge the gap between technology and didactics. Therefore it deals with different topics concerning objectives and methods of teaching and learning. For example each tool is discussed in relation to its didactical suitability for either teaching the skill of knowledge reproduction, method application or problem solving. Or it is classified concerning to its potential for teacher-directed, team-directed, or self-directed learning.
- Experience: As there is quite a lot of knowledge available that is based on personal experience with some specific tool, one part of HEURIS is dedicated to practical reports.

The first version of the information system contains knowledge about tools which are used within different NDIT/FPIT courses. These are mainly tools for asynchronous or synchronous communication (e.g. mail, discussion list, video conferencing, application sharing, chat). In a second version we would like to provide also more specific knowledge such as information concerning format standards (e.g. text, graphics) or multimedia components (e.g. audio, video, simulation). During the first phase the information is accessible for project members only, in the future we would like to open it also for external users.

5. Conclusion

Up to now we have carried out 8 courses, two of them offered simultaneously in Switzerland and Africa in collaboration with ESMT (Ecole Supérieure Multinationale des Télécommunications) of Dakar. In the near future more of the NDIT/FPIT courses will be upgraded with the newly developed interactive courseware or prepared for new dissemination methods. All courses are stringently evaluated with the collaboration of the students and the teachers. The experiences gained up to now show excellent progress in the quality and acceptance of the virtual classroom courses. The aim is to provide a substantial part of the full program in this form. This will facilitate access to this program for students who are fully involved in their professional work and who therefore could not take advantage of an in-deepening continuing education.

CLASS™ - Using Innovative Technologies for Distance Education

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Abstract: The CLASS™ (Communications, Learning, and Assessment in a Student-center System) Project at the University of Nebraska is creating an accredited, electronically delivered high school diploma sequence for delivery on the World Wide Web. Because of the unique distance learning environment of the Web, the CLASS™ Project has developed an instructional created Web-based instructional design features to maximize the learning opportunities afforded by this electronic education environment. Both the CLASS™ design features and instructional design model are transferable and scaleable to the needs of other distance learning programs.

The Project

The CLASS™ Project's goal is to make available on the World Wide Web a complete, accredited, high school diploma sequence. The Department of Distance Education of the University of Nebraska-Lincoln (UNL) is recipient of $18 million in federal funding to develop the sequence. When completed in 2001, CLASS™ will have available to students 55 courses from which to choose to complete these requirements.

The Department of Distance Education is uniquely suited to provide this diploma sequence. Among its units is the Independent Study High School (ISHS). The ISHS is the only university-based, fully accredited, independent study high school in the United States. In operation since 1929 and accredited by both the North Central Association of Colleges and Schools and the Nebraska Department of Education (NDE), the ISHS currently serves about 15,000 students annually in 136 countries. The students can choose among 138 print-based courses in addition to the electronic courses. Enrollment is open, with students registering throughout the year.

The Course Design

The development of the courses for this project required the recognition of several factors. Paramount among these was the World Wide Web offered a new and different educational delivery method. Therefore, current print-based courses could not simply be transferred to the Web. Second, in order to fully utilize the potential of the Web as an educational delivery system there would need to be new software and technologies developed. Third, and premised on the first two points, production of these courses would take place in a manner different than traditional multimedia production. To put it simply, the project would require invention in both the areas of instructional design and technology.

CLASS™ is a dynamically interactive, student-centered course environment delivered electronically via the World Wide Web. Students access moving imagery, graphics, sound, and text within a seamless navigational system that encourages individualized learning, discovery and exploration. "Seamless" means that students do not have to open and close applications to move from–for instance–a text screen to simulation (or to a video or discussion group). The technology for supporting all the media of a course is included in CLASS™.

CLASS™ provides new avenues of educational access through cost-effective alternatives to conventional classroom teaching situations. These new avenues are particularly important when reaching out to all levels of students, including nontraditional, geographically isolated or disadvantaged segments of the population, at-risk and the gifted.

CLASS™ provides individual learners with access to interactive, flexible course materials, including data, graphics and video, and incorporates electronic interaction between learners and instructors. CLASS™ helps students manage this multitude of materials by providing an electronic "notebook" where students can store and sort everything from video to text. They can share this information with other students or with the teacher.

Courses are formatted especially for electronic delivery. Students are responsible for their own learning, making choices in the paths they take through the course, and selecting from many different learning activities and experiences. Course units develop increasing levels of complexity and sophistication within the course content. As students move through the units, their interaction with the materials requires an ever-widening understanding of the concepts being presented.

Students determine their own mastery of the material by taking practice exams that are electronically evaluated, students receive the results in only a few seconds. Examinations and projects are evaluated electronically or by the teacher.

CLASS™ instructional design provides for interaction between learners and instructors, stressing the development of life and workplace skills, citizenship responsibilities and critical thinking. New technologies provide learners with access to digital libraries from national, historic, scientific and research centers over the global and national information infrastructure.

Conclusion

The CLASS™ instructional design model is a work in progress, regularly revisited and revised. It is used for developing all CLASS™ courses and easily transfers to a variety of Web-based instructional needs. Whether one is developing a single lesson tutorial or an accredited semester-length course, the CLASS™ instructional model is sizable to the situation. This instructional design model enables input from a variety of sources, and empowers the designers with feedback before, during and after the process.

CLASS™ instructional features give distance education students the opportunity to learn using a myriad of learning tools that are unique to Web-based distance education, including student-to-student communication, dynamic learning activities, student-selected learning paths, multimedia-reinforced learning, self-monitoring of progress and the ability to create multimedia portfolios, all in a seamless learning environment not bound by time nor space.

Because of its size and scope, the CLASS™ Project has the potential to revolutionize the distance delivery of courses to individual students, learning centers and schools that cannot afford or do not have the ability to offer specialized courses such as English as a Second Language.

Currently 32 courses are open for enrollment. Examples of the courses, along with additional information on CLASS™ can be found at http://class.unl.edu.

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On-line Learning 'Assumes' On-line Delivery Skills

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Abstract: Remote, distant, on-line learning is gathering momentum. However the ability of traditional 'class-based' teachers and lecturers is not keeping pace with this change. The framework being developed at the University endeavour to provide a variety of means and mechanisms to address the needs of the staff at both the conceptual and practical level.

It is often said that we are entering or even part of the Information Age. This coming period could equally be called the Age of Learning: The sheer quantity of learning taking place in the world is already many times greater than in the past. For example, not very long ago, and in many parts of the world, young people would learn skills they could use in their work throughout life. Today, in industrial countries, most people are doing jobs that did not exist when they were born. The most important skill determining a person's life pattern has already become the ability to learn new skills, to take in new concepts, to assess new situations, to deal with the unexpected. The competitive ability is the ability to learn. Information technology, from television to computers, affords an opportunity to enhance the learning experience. However, to date, classroom enhancements have replaced traditional apparatus rather than the process or didactic model of teaching:

⇒ The chalkboard replaced the slate;
⇒ the whiteboard replaced the chalkboard;
⇒ the OHP replaced the whiteboard;
⇒ software (Microsoft PowerPoint™ et al) replaced the OHP

Teachers/ lecturers felt comfortable with these changes as they were replacing the quill with the keyboard, the delivery mechanism, process and interface was essentially the same. So how to progress, there is a need to enable staff to consider the pedagogic implication of the on-line learning environment rather than the content. In order to implement and sustain remote, distance based computer mediated courses with a high probability of success, the following should be considered as the critical areas:

- enhancing/extending autonomous learning and productivity in the face-to-face traditional classroom setting
- creating a Web-presence with easy access to 'basic' information about online courses and interactive learning materials
- discovering/developing tools and standards to support new learning environments
- advancing our understanding of the virtual and distance university
- increasing community/off-campus access to the teaching-learning community
- providing evidence of the viability of these concepts

Staff are currently being asked to develop material for on-line delivery. This is an anathema to them. Not because of any motive other than competence in the pedagogy, technology environment etc. They generally teach the way in which they have been taught. As tutors they feel in control of this environment of physically teaching students, they are 'happy' with the quality and control and standard of the 'interface'. To introduce another medium is quite threatening and may well affect the quality of the experience. There is a need to maintain quality within our content and delivery. According to the literature, quality is concerned with meeting a defined specification(s). Clearly, for learning to be considered as quality learning, it must also meet prescribed and accepted criteria. Nightingale and O'Neil (1994: p. 54), suggest that the indicators of high quality learning having taken place are: -

- being able to discover knowledge for oneself
- long term retention of knowledge (implying that there is understanding)
- being able to perceive relations between old and new knowledge
- being able to create new knowledge
- being able to apply knowledge to solving problems
- being able to communicate one's knowledge to others
- wanting to know more

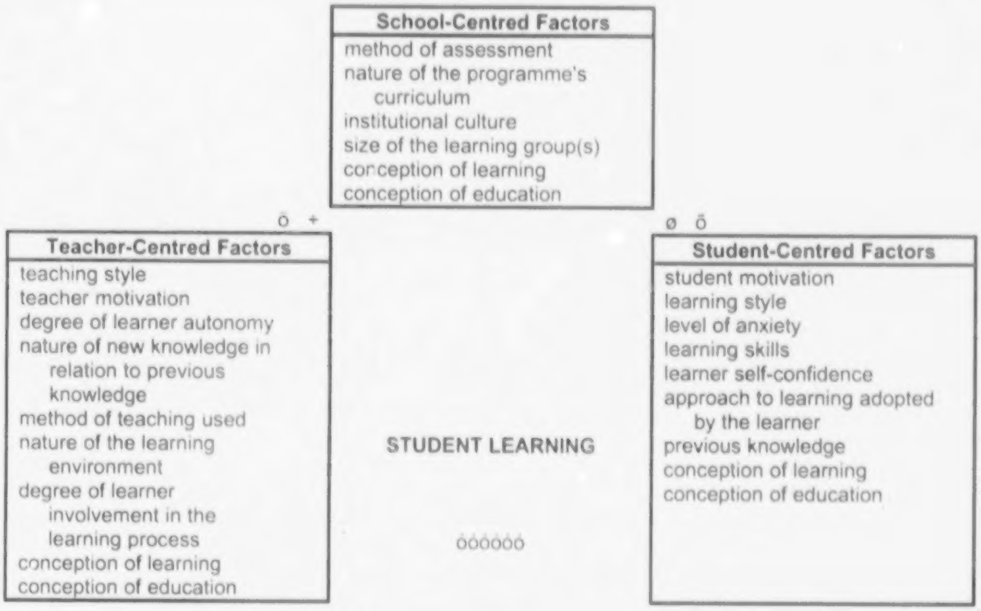
But, they add the caveat that it is only possible to achieve this specification where certain pre-requisites for quality in learning are in existence:-

- the learner is ready to meet the demands of the learning task(s)
- there is a reason for learning (acceptable reason, to the student)
- the learner is active during learning
- adequate support is provided by the environment in which that learning occurs

The adoption and implementation of such a model by staff in developing for an on-line delivery platform or for an on-line supported delivery platform will require a greater understanding of both the learning process itself, and also the most appropriate means to facilitate that process. This understanding is a pre-requisite for effective course design. But, I would suggest that at present, part of the problem is the differing conceptions held by academic staff as to exactly what; a) learning is, and b) what on-line facilitated learning is. But perhaps more importantly, future developments in course design, structure and delivery will continue to be at best misguided, and at worst potentially damaging to the quality of the learning experiences that are offered.

The challenge is to develop a curriculum which can emphasise interconnections between learning pathways, the practical application of knowledge in a variety of contexts and flexible relationships between core and specialist knowledge. It must be based on sound pedagogy. The focus on tutors is not on the training but on the facilitation of central processes of learning which too often is interpreted as something which is transmitted to people rather than an activity for which they themselves have responsibility. The teachers of tomorrow must have some involvement, experience and opinion of 'student-centred learning', 'flexible learning', 'open learning', 'active learning', 'on-line learning' etc. Effective learning within this environment is:-

1) a function of the interaction between, *and* the interdependence of, 3 groups of factors
2) and a cause of that interaction



School-Centred Factors
method of assessment
nature of the programme's curriculum
institutional culture
size of the learning group(s)
conception of learning
conception of education

Teacher-Centred Factors
teaching style
teacher motivation
degree of learner autonomy
nature of new knowledge in relation to previous knowledge
method of teaching used
nature of the learning environment
degree of learner involvement in the learning process
conception of learning
conception of education

STUDENT LEARNING

Student-Centred Factors
student motivation
learning style
level of anxiety
learning skills
learner self-confidence
approach to learning adopted by the learner
previous knowledge
conception of learning
conception of education

Robotham, 1996

The approach of the tutors in allowing cross fertilisation and conceptual development of the student and tutor and technology must be fostered. It must allow various "partnerships" into which students will enter. Successful learning depends on success in establishing and developing such partnerships - with tutors and with collaborators. However, such an attitude is not free of complication. It may be argued that one important goal of formal education is to cultivate a capacity to learn independently; in a sense to find some release from learning - as - partnership. Now, claims of this sort introduce an element of tension: we wish to develop partnerships for purposes of socially mediated learning, but we also wish to cultivate in the learner a certain autonomy. Tension of aims need not imply conflict of aims. Indeed, far from being in conflict there may be necessary developmental relationship between socially organised cognitive functioning and that which is 'private' or autonomous to the individual (Vygotsky, 1978).

Thus, in practice, one thing teachers much surely consider is how they should manage the learning process in terms of a balance of emphasis between pupil autonomy and interpersonal exchange.

Nightingale, P., & O'Neil, M.(1994). Achieving quality learning in higher education. London: Kogan Page.

Robotham, D.(1996). Effectiveness of self directed learning (Thesis).

Massachusetts. Harvard University Press.

Introducing the Electronic Library Image Service for Europe (ELISE)

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Abstract: Since 1993, De Montfort University and eight other institutions situated in the United Kingdom, Belgium, Ireland and the Netherlands, have been working on a project called "Electronic Library Image Service for Europe" (ELISE). This paper introduces the ELISE project and outlines a scenario that involves establishing an operational electronic image retrieval service in Europe that can accommodate additional image banks.

1. Introduction

The European Commission has funded the ELISE project through two phases. The initial phase began in February 1993 and concluded in 1995, it resumed in 1996 and is due to be completed by the end of this year.

In the initial phase, ELISE was successful in producing a working prototype for providing image access from remote sites (using the Internet, but before the World Wide Web was established). It modelled a European Community facility that provided access to full colour image banks with supporting textual data and was held in the different project partner states. With the conclusion of ELISE I, several demonstrations and product launches took place in both the UK and in the Netherlands. ELISE II has been investigating the feasibility of providing images over the Internet, using standard Web facilities, but providing additional user control, copyright support and charging models. The project has developed a comprehensive JAVA based, distributed demonstration system that provides controlled access to images and associated textual information. Eight of the partners are providing a variety of image content, from cultural and artistic, to scientific and medical subjects.

2. Scenario for ELISE

As part of the project an investigation into the possibility of commercialising ELISE is taking place. An economic model has been completed as a result of the project team assessing the current demands and needs of the picture library market. This model is currently being tailored to a potential ELISE consortium and a business plan is being developed that considers possible commercial opportunities for the service.

The project partners have established the following objectives:

- To identify areas where there is greatest benefit to be gained from networked image banks.
- To promote partners own image collections and provide access to the world-wide market via the ELISE web-site.
- To continually advance ELISE with technological developments so that the service becomes and remains competitive in the world-wide market.
- To participate in the development of image related services to the educational community and cultural sectors.

The ELISE Business Plan will target the educational and cultural sectors initially in the United Kingdom and expand into Europe within five years.

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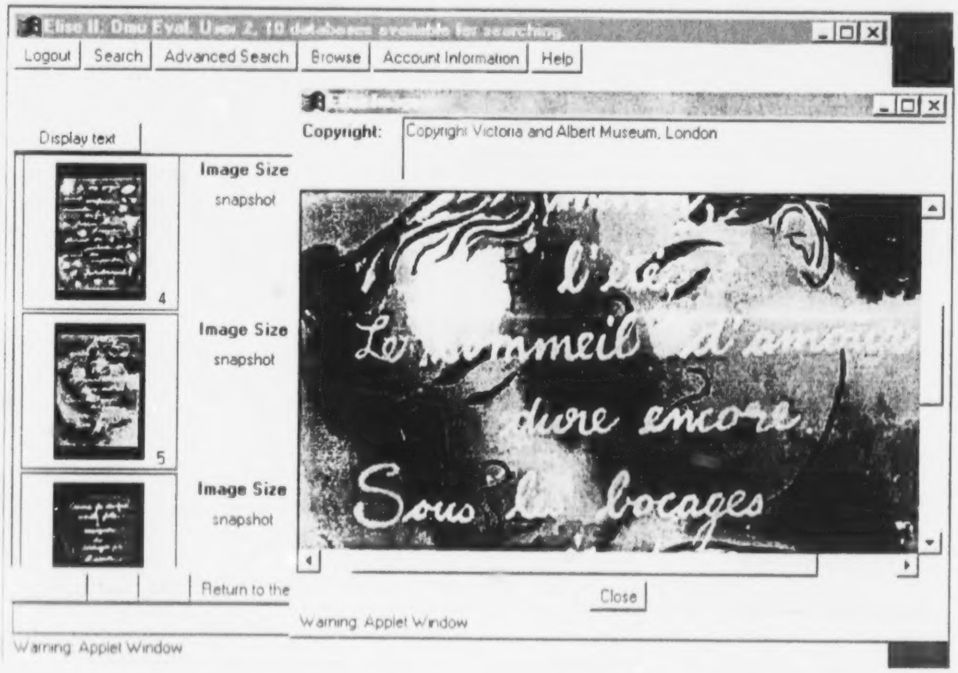
The third annual Picture Agency Council of America (PACA) International conference was held in New York in November 1998. At this conference, Jonathon Klein of Getty Images acknowledged that "sites which provide an opportunity for smaller libraries to place their images on a collective site may potentially provide a solution to the dilemma facing small and mid-size companies" [Harding 1998].

It is envisaged that ELISE will continue to be a distributed system with centralised access and administration. Individual institutions will make their collections available to the educational and general world-wide market via a central web-site operated by an ELISE European Economic Interest Grouping (EEIG). Centralised search and billing facilities would be provided at the image banks request. Image banks and picture libraries connected to ELISE would maintain ownership rights and maintenance of their collection/s.

There are already a number of image banks on the Internet, some operate on a non-profit basis while others are commercially oriented. Some image banks are very content specific whilst others are more generalised and cover a wide range of subject matter. With ELISE, all image banks/picture libraries have equal opportunity of their images being requested/accessed.


Elise II: Dmu Eval. User 2, 10 databases available for searching
Logout
Search
Advanced Search
Browse
Account Information
Help
Display text
Image Size
snapshot
4
Image Size
snapshot
5
Image Size
snapshot
Return to the
Close
Warning: Applet Window
Warning: Applet Window
Le sommeil ... dure encore
Sous les bocages

Copyright: Copyright Victoria and Albert Museum, London

Existing image banks/picture libraries can become associated with ELISE, either by adding a Standard Network Interface (using Z39.50 protocols) to their server, or by filling in an online form and submitting their collection. Where the collections of the image banks/picture libraries are not digitised, ELISE has the opportunity of providing the service of digitising, cataloguing and maintaining the collection on their behalf. ELISE would activate accounts for potential users in the form of subscriptions for the higher education sector to enable ease of administration, and user accounts for the general market.

For more information about ELISE, visit the following url: http://severn.dmu.ac.uk/elise/

3. References

[Harding 1998] Harding, R. (1998). The Image Business in Perspective, Light Box: The BAPLA Magazine Issue Seven , page 5.

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Effective Online Teaching/Learning: A Case Study

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Abstract: The University of Hawai'i at Manoa was funded by the Alfred P. Foundation to create and offer an asynchronous learning network (ALN) course to outreach students on neighbor islands of Maui and Molokai. The delivery of the course resulted in data which showed that effective collaborative asynchronous learning environment incorporates a carefully planned learner-instructor, learner-content, and learner-learner interaction.

As distance education begins to get increasingly defined in terms of online education, there is a trend toward reintegrating the learner-instructor as well as learner-learner interaction in teaching at a distance. The focus is increasingly on rethinking teaching-learning process so that all distance students become active learners. Online education is shown to be effective in creating collaborative learning situations. It has also been seen that unless specially designed activities are integrated to promote learner-content interaction, the nature of peer interaction can be quite superficial.

We kept the above pedagogical issues in mind as we designed and delivered an experimental asynchronous learning course at the University of Hawaii at Manoa. The project was funded by the Alfred P. Foundation to study the feasibility and effectiveness of an asynchronous learning network (ALN) course for the outreach students on neighbor islands of Maui and Molokai.

The Course and the Students

CAS 403-Information Technology and Culture was an upper division interdisciplinary course. The course materials used in CAS 403 came from a variety of sources: print resources, the instructor's online overviews of weekly reading assignments, books, journal articles, various online resources, and even online student projects from previous courses. Lotus Notes' LearningSpace was the software used for delivering the course. For participating in the course, students had to visit the course site regularly and participate in all activities on a weekly basis. As we designed weekly class activities for students, we focused on creating a learner-centered environment. The class lectures or lecture notes were replaced by weekly overviews and specific discussion topics. Even students' detailed responses became part of the reading materials. We focused our attention on creating a learning environment that would allow learner-content interaction, learner-teacher interaction, and learner-learner interaction regularly.

As far as the general format of the course was concerned, each student was required to read the assigned reading material and respond to it on a weekly basis. The learner-content interaction was facilitated by the instructor's weekly overviews of the reading assignments. The purpose of the reader responses was to see that the instructional goals were being achieved and when they were not, timely intervention became possible in maintaining student interest in the subject matter or in the learning situation as such. By the end of the second week, it became clear that the quality of a great number of responses was so good that other students should be given an opportunity to read them. So starting from the second week, the instructor started posting the responses for everybody to read; initially, just the best ones, but as the semester progressed, all responses were posted for everyone to read. Different perspectives helped them understand ideas that they had missed or not understood in their own reading.

Whereas reader responses were focused exercises to evaluate students' understanding of the content, the discussion assignments were meant to serve as a platform for the application of ideas. We initiated one or two discussion threads every week and these were directly linked to the content overviews for that week. The students were free to initiate other discussion threads which they frequently did. We reinforced right from the beginning that there was no wrong or right response to the discussion assignments, only different perspectives and different levels of understanding. The open-ended nature of discussions gave students freedom to choose how they wanted to respond to the entries. In this controlled, yet very open discussion space, students got actively involved and responded to each other in creative ways. A lot of faculty who have incorporated electronic conferencing tend to complain that it takes too much of their time since messages come pouring in at different times. In CAS 403, discussions were primarily a space where students interacted, even as they were constantly aware that their discussion was being monitored by the instructor who intervened only when students needed help or if they went off track. Since the instructor held back, soon more advanced students began to help those who were having difficulties with comprehending ideas or their relationship. The instructor's occasional strategic intervention reassured students that the instructor was indeed monitoring all class discussions even though she did not actively participate. This strategy was very useful in handling on the average 80-90 submissions/week.

In order to increase learning effectiveness, we integrated assessment activities into the course design right from the beginning which allowed us to monitor on a weekly basis if the learning goals were being achieved. A background test before the course actually began gave us an idea about students' prior knowledge. Similarly the reader response and discussion assignments that students were required to submit on a weekly basis showed us if students were learning the concepts or skills that were part of the course objectives. The Paper-Prep quiz at the end of the first two units and the second one at the end of the last two units allowed us to see if students had in fact mastered the assigned texts at the conceptual level. If some students were having difficulties understanding the subject matter, the instructor intervened in a timely fashion before it was too late. As in a face-to-face course, students were also required to write two essays. In light of the fact that students wrote long reader responses on a weekly basis, the number of essays assigned in this course was reduced from three to two. Students were asked to write one short essay in the middle of the semester and one long research paper at the end of the semester. Except for one or two essays, all the essays were posted for everybody to read. The gradable assessments, essays, were thus only one aspect of the course where the focus had shifted from teaching effectiveness to learning effectiveness.

It was obvious both to the instructor and the students by the end of the second week about the importance of time management. Each week the twenty students enrolled in the course generated on the average a total number of 80 submissions which were dispersed over different days of the week. Some sort of time-frame needed to be developed in order for the course to run efficiently and to keep the students motivated to participate actively. The external pacing, it was obvious, was crucial for the collaborative work to take place. All assignments for the week were due by the Sunday of that week. Similarly, the instructor provided individual feedback by the Tuesday of the following week. The instructor checked on the course discussion everyday, only occasionally participating. The class discussion become primarily a space for peer interaction. All new assignments and weekly overviews of the reading assignments were up on Monday of every week. As the instructor strictly followed the schedule herself, the students too were motivated to do so. She provided feedback to students' individual responses on a weekly basis. It created a context where each student felt directly linked to the instructor while at the same time feeling a part of the community of learners. It also created a classroom dynamics where students felt that the instructor was monitoring all class discussions and individual submissions, even though she did not participate actively in class discussions.

Conclusion

Through teaching this course, it became obvious that an effective multi-layered learning environment incorporates learner/content, learner/ instructor and learner/learner interaction which creates a social context for receiving, exchanging and transforming knowledge. The process of teaching/learning becomes a complex mode of interaction amongst the learners, the instructor, and the content of the course. We also noted that the role of the instructor is crucial as the content expert if deeper learning is to take place—to explain, to clarify, to direct and guide students as they learn new concepts and their relationships. Since the work done by students in an asynchronous course is in writing, it can be reviewed both by students and by the instructor anytime from anywhere. The learning-teaching act thus need no longer be separated in distance courses even as self-learning is still one of the important aspects of distance learning. In this respect, asynchronous online education can be compared to face-to-face seminar classes which usually focus around student discussions rather than instructor lectures. An asynchronous class can be run in a way that promotes genuine collaborative work where the more advanced students begin to help those who are less advanced. Students can indeed feel a sense of ownership in such a course, as the energy they invest in their work does not dissipate at the instructor's desk, but is passed on to their peers.

Development and Use of Interactive Websites K-12

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Abstract: Two interactive websites, focusing on a national estuary and a shipwreck, have recently been developed. These websites have been used in classrooms to help students understand the attributes of each environment, while preserving the sanctity of the sites. During interactive sessions, students can watch activity through streamed video and then pose questions through a chat-room capability. Local experts at each site respond to students' questions. Both teachers and students report high interest in these interactive sessions, in spite of some technical difficulties during initial use of the websites. Both sites have also proven useful as contexts for creating interdisciplinary instructional activities.

Estuary Project

The Estuary Project website is a cooperative effort of the North Carolina National Estuarine Research Reserve, the North Carolina Department of Public Instruction, the Center for Science, Mathematics, and Technology, and Marine Grafics. The Estuary Project is designed to educate school children and teachers about estuarine environments, with the expectation that this knowledge will help future generations protect the estuary environment at the Rachel Carson Sanctuary on Pivers Island, off Beaufort, NC. The website lets public school students interact with this work without physically being at the Sanctuary. Virtual visits encourage the development of understanding about estuaries without causing environmental damage.

The Estuary Project website (*http://www.marinegrafics.com/livecam/mainpage.htm*) was created in fall 1998 by Bill Lovin of Marine Grafics and Susan Lovelace, Director of the North Carolina National Estuarine Research Reserve. The main page contains a live shot (updated every minute during broadcasts) transmitted from the Sanctuary, a live underwater shot (updated every 15-minutes) showing a data-logger which checks weather and water conditions (e.g., Air Temperature, Water Temperature, Dissolved Oxygen). In addition there are links to resources, lesson plans, frequently asked questions, a scrapbook of pictures, and acknowledgments of sponsoring agencies.

Shipwreck Project

On March 3, 1998, North Carolina Governor Jim Hunt announced the discovery of what is believed to be the remains of the Queen Anne's Revenge (QAR). The long lost flagship of the infamous pirate, Blackbeard, ran aground on a sandbar and sank off the coast of Beaufort, NC, in June 1718. The discovery of the shipwreck was first made on November 21, 1996, when divers from Intersal, Inc., reported a 20-foot by 30-foot mound of artifacts, such as cannons and ballast cobbles, as well as portions of a wooden hull, buried under the sand. The wreck and its contents are very fragile because of age and underwater location. Over the next few years, divers will explore the shipwreck, and artifacts will be brought to the surface.

An education website (*http://blackbeard.eastnet.ecu.edu*) for QAR was developed in April 1998 by the Division of Archives and History within the North Carolina Department of Cultural Resources, UNC-TV, the

North Carolina Department of Public Instruction, and the Center at ECU. (Interestingly, the mascot for ECU is the Pirates!) The goal of this website is to protect, research, document, recover, and interpret the archeological find. This website has is the official educational site for information about QAR and includes five categories of information: Dive Logs (details of the exploration and archeological dives), Historical (information on Blackbeard and the Queen Anne's Revenge), Photo Gallery (photos of the archeological exploration and artifacts taken from the site), Educators (lesson plans to help students become scientists and historians), Artifacts (methods used to recover and restore artifacts).

Use of the Websites in Classrooms

There have been two interactive demonstrations of the use of the Estuary website in classrooms. The first was in 1998 on November 3, 4, and 5 (for elementary schools, middle schools, and high schools). At a reserved time, registered classes used passwords to gain access to the live streaming video page. A video camera followed a group of students and teachers and transmitted live pictures from the Sanctuary. Throughout the transmission, a "Chat" window was open for communication. (Audio was not available during this demonstration.) Scientists at the site used this capability to explain what was happening in the video. At any time during the transmission, students could submit questions via this same Chat window, and responses were made by the scientists at the site or at the Sanctuary office.

The second demonstration was during the Supercomputer Conference in Orlando, FL, on November 9, 1998. Connections were made via IP technology among the Sanctuary, about 200 teachers at the conference, and schools in Illinois, Iowa, and North Carolina. This demonstration was essentially the same as for the earlier demonstration, with only video and "Chat" capabilities being available.

Students asked a surprising range of questions (not all necessarily appropriate!). The on-task questions below indicated that students were focusing on critical features of the environmental work.

How tall can the grass grow?
How much salt is in the water?
What is the data logger hooked up to?
Is there a special kind of net you use to gather the samples?
How does erosion material affect the marine life?
Can you use the number of snails to determine how pollution is affecting the estuary?

Recommendations

One of the lessons learned is that students can easily flood the system with questions. •Both teachers and students need to be prepared about what kinds of questions are appropriate and how many questions one class might reasonably submit. It might also be advantageous to identify a set of frequently asked questions and prepare a "study guide" ahead of time so that answers to these questions can be in each classroom at all times. Alternately, a moderator might filter the questions to prevent duplicate or inappropriate questions.

Both teachers and teacher educators who participated in the demonstrations recognized the need for broadening our views about communication. As Internet conversations become more widely used in classrooms, considerable thought needs to be given to how to design responses to support students' learning. Too, ways of threading discussions need to be studied so that students are not lost in mountains of information (e.g., rapid-fire questions submitted from multiple sites simultaneously).

There might be advantages of preparing video clips ahead of time, rather than using live streamed video. These clips could be accompanied by predesigned questions that focus students' discussion more directly on the content to be learned. This kind of environment should not replace the use of live video, but it might be a better introduction to the study of the content of a website than simply putting students on-line immediately.

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Transporting Environmental Communication Across International Boundaries

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Environmental problems have no boundaries; the World Wide Web and the Internet have no boundaries. That's why the World Wide Web and the Internet are the perfect tools for international communication about environmental issues.

Overpopulation; pollution of land, water and air; and resource depletion are environmental concerns that cross man-made national boundaries to affect living systems globally. Engendering human awareness and initiating solutions to environmental problems require cooperative efforts of environmental communicators from all countries, working together to promote global environmental sustainability. The Internet enhances opportunities for dialogue that involves citizens as well as professionals and leaders in the search for solutions to common problems. It is in this spirit of international cooperation for environmental protection that the I-STEP Project was formulated.

The I-STEP Project is an international environmental communication project that utilizes the World Wide Web for research and information dissemination concerning environmental issues and that utilizes the Internet as a means to achieve dialogue about environmental issues. The I-STEP Project is an example of an educational application of the World Wide Web and Internet as teaching, learning and pedagogical tools. The project can be used as a "model" for future educational and information dissemination projects about environmental and social issues because this project fosters collaborative education and problem-solving by means of the World Wide Web and the Internet.

I-STEP stands for "International Students Together for Environmental Protection." The meaning of the I-STEP concept for those involved is as follows: "I, as a citizen of Earth, will take steps in the direction of environmental problem solution." The philosophy behind the project is that if each person takes steps toward environmental protection, the collective effort can result in dramatic improvement in the environmental health of the planet. The "steps" that people can take as a result of this project and the methods to evaluate such actions are outlined on a website with free access for the public.

The I-STEP Project began with an international faculty exchange in which faculty from the United States and The Netherlands utilized the Internet and teleconferencing to formulate a program of collaborative learning. The project involved a student exchange in which students of different countries worked together to produce environmental communication campaigns to increase public awareness of environmental problems (including implications of such problems), and to initiate individual, community and company actions in pursuit of solutions. The World Wide Web was utilized for research and information gathering and the Internet was used as a communication tool for dialogue.

The first I-STEP Project involved an exchange between faculty and students at Hanzehogeschool in Groningen, The Netherlands, and the School of Communication at Northern Arizona University in Flagstaff, Arizona. This exchange took place during Spring and Summer of 1998, at which time Hanzehogeschool van Groningen was conducting its "English Semester." During the "English Semester," which is hosted each year at Hanzehogeschool van Groningen, students from various European countries and the United States attend Hanzehogeschool van Groningen for the purposes of working together on communication campaigns with all classes taught and work produced in English, which is considered to be a "common" international language. Students participating were not only from The Netherlands and the United States, but also from England, Spain, Italy, France, Belgium, Germany, and Sweden.

The topic for student-produced communication campaigns for the I-STEP Project was "Global Warming," which was appropriate due to the recent Koyoto Conference and since the topic and its related issues and consequences are of relevance to people from all countries. The sponsor obtained for the project was Greenpeace, International, whose international offices are located in Amsterdam, The Netherlands. Greenpeace sent a representative to Hanzehogeschool to discuss the topic with students, and Greenpeace also allowed students access to all Greenpeace files. The agreement was that students would produce communication campaigns that could be used by Greenpeace, if desired, and that these campaigns would also be placed on the Internet for public access.

Because the issue of global warming is complex and since it involves many issues of conservation of resources as well as sustainability issues, a great deal of research was conducted on the World Wide Web prior to the determination of communication campaign procedures. Examples of websites explored included those of Greenpeace, the Union of Concerned Scientists, Kyoto Conference, Second Nature, the President's Council on Sustainable Development, as well as appropriate links to additional information about the topic at other locations. One website that was particularly helpful in formulating "electronic brochures" and "electronic evaluation methods" was the site for the Nordlicht Campaign, hosted by the Institute for Psychology at University of Kiel in Germany. Communication techniques, research techniques, audience analysis, and many other necessary components of successful communication campaigns were studied and practiced before work on the campaigns for Greenpeace. Once research was complete, students then worked in teams to produce actual campaign materials. Such materials included brochures, posters, videos, letters and feature articles on issues related to global warming.

Because one cause of global warming is excessive energy consumption, many campaigns are directed to the conservation of energy. Examples of student produced campaigns follow. One group produced a campaign entitled "Turn Down the Heat" targeted to students in higher economic polytechnic schools in The Netherlands. The goal of this campaign is conservation of electric energy by means of individual actions such as turning down the heat when leaving a room and buying energy efficient light bulbs. Another student group produced a campaign entitled "Are You Ready for a Long-Term Relationship?" directed at homeowners. The goal of this campaign is for homeowners to reduce energy consumption by purchasing energy saving devices including domestic appliances and light bulbs, increasing wall and floor insulation, and adding solar panels. The communication plan of another group was directed to school children between the ages of 12 and 18 to increase their awareness of the problem of global warming through a series of educational activities and experiences.

While students at Hanzehogeschool were producing campaigns for the I-STEP Project in The Netherlands, students in environmental communication classes at Northern Arizona University were also producing campaign materials, with students in an environmental research and reporting class writing articles for publication on the Internet. Titles of published articles are as follows: "Monorails and People Movers," "Bald Eagles and the Threat of Global Warming," "Power Plants or Power Plants?," "Implications of Global Warming for Riparian Areas," "Make Your Vehicle Environmentally Friendly," "The Impact of Recycling on Global Warming," "The Issues Behind Global Warming and Economic Policy," "Jobs: The Next Global Warming Crisis," and "Wildlife Predictions due to Global Warming."

The I-STEP Project's "Global Warming" Campaign materials have been made available to an international public audience at a website on the Internet. Communication campaigns and articles may be viewed at: http://www.nau.edu/soc/ecrc/ under the heading I-STEP Project. It is hoped that this information will increase public awareness and action concerning global warming issues, and it is hoped that these campaign projects will be used as examples for similar public awareness/action campaigns globally. It is with this spirit of sharing information and ideas for solving environmental problems that the I-STEP Project was designed. Technology (World Wide Web and Internet) that wasn't available just a few years ago has enhanced the success of this project and is expected to further enhance public knowledge in the future.

One of the most valuable outcomes of this first I-STEP Project is the bond formed by international students in the quest for solutions to environmental problems that confront living systems today. These students are remaining in contact with each other via e-mail as they return to their respective countries where they are assuming positions as environmental communicators. It is expected that these individuals will continue to share ideas and communication plans as they become leaders in efforts to promote environmental sustainability in their own countries. The World Wide Web and the Internet are the tools that are making this possible.

An innovative use of the Internet to teach alcohol awareness to grade 7 and 8 Students

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Abstract: This paper describes the innovative use of the Internet to teach alcohol awareness to French and English Grade 7 and 8 students in the province of New Brunswick, Canada. The initiative got its start with in 1997 with a $1.2 M (CDN) grant from the Brewers Association of Canada. Student access and maintenance concerns have driven the choice of delivery technologies. The primary resource is a set of Internet-based learning activities and resources that teachers can use to supplement their classroom activities. While evaluation efforts are on-going, initial reactions to the site have been favorable.

The NEW BRUNSWICK EDUCATIONAL RESOURCE DEVELOPMENT PILOT PROJECT PARTNERSHIP got its start in 1997 with a $1.2 M (CDN) grant from the Brewers Association of Canada (BAC). The Brewers Association designates monies each year to support education and awareness programs in the community around responsible alcohol use. In funding this Project, the goal of the BAC is to improve the quality and breadth of alcohol abuse prevention education in Canadian schools. The BAC and its partners are developing and pilot testing educational resource materials in New Brunswick classrooms that will then be made available to all Canadian teachers and students. More specifically, the Project's goal is to develop educational resource materials, in French and English, for 13-14 year olds that provide them with appropriate information on the use, misuse and abuse of alcohol. While the focus of this Project is on prevention of underage consumption, it also incorporates some harm minimization strategies. A group of curriculum specialists, content experts, instructional designers and multimedia specialists has been charged with building an engaging and effective technology based set of curriculum materials. The Project involves partnerships with the Université de Moncton, the University of New Brunswick, the Provincial Department of Education, NBTel, and Performx Inc., one of Canada's largest technology-based learning development companies.

Student access and maintenance concerns have driven the choice of delivery technologies. The primary resource will be Web and Internet-based electronic learning activities and resources that teachers can use to supplement their classroom activities. The development team is using a third generation browser and no software "plug-ins" will be needed. The development team is also limiting the graphic richness of the site to ensure fast download times over 28.8 kbs modems. The site will contain interactive activities that students can use to acquire information, skills and attitudes. Contingent on policy advice from the Department of Education, e-mail, links to other sites like MADD, CCSA, simulations, and other techniques will be used. While there may be some print material associated with the Project, every effort is being made to keep such materials to a minimum to reduce the costs that schools would incur in utilizing the final product. Teacher, student and parent support materials will also be developed so that they know how to use the Project's resources.

From the outset, everyone involved felt strongly that technology should not be used simply to deliver alcohol-related facts and figures to learners through their classroom computers. Instead, the program developers believed that learners should be engaged through a series of collaborative activities or "projects" supplemented with individual web-based activities aimed at building student's knowledge of important concepts Grabinger (1996). The design of the site was inspired by the recent work of Wilson (1996) around constructivist learning environments and, in particular, by an article by Reeves (1996) which stressed the importance of creating learning environments where students learn *with* technology rather that through it.

The development process was aided by creation of two design documents, which helped bring focus to the early planning efforts. One, the site map, provided a one page conceptual snap shot of the finished site. The map detailed each of the major "content vessels" and -- at a high level -- how users would be able to navigate around the site. The other, the content matrix, provided additional detail on the contents of each part of the site. This matrix also provided Performx, the development company chosen to work on the project with enough information to adequately scope and cost the development work. Both documents envisaged designing the site for three target audiences (students, parents and teachers) and providing them with common tools such as an Information Resource Centre.

Project descriptions (as well as support materials for teachers) will reside on the web site. In addition, the web site will contain a rich repository of material related to alcohol use in society. These materials will include graphs showing patterns of alcohol use across different groups, audio clips of people describing the reasons they use alcohol or helping professionals describing their interactions with problem drinkers. Learners will be encouraged to work collaboratively both within the classroom and with learners at other schools. Projects will culminate with an "artifact" of some kind -- a poster or newspaper article, for example -- that would, in turn, be posted to the "gallery" section of the web site. Two other sections of the site will be designed specifically for teachers and parents. The teacher's section will include a variety of strategies around effectively deploying the web resources in the classroom. The parent's section will, among other things, provide information about how to discuss alcohol-related issues with early teens.

While building on the same fundamental structure, the French and English teams have developed a unique set of activities and used strikingly different visual metaphors to frame their sites. The French team chose a "gritty urban" look for their site. The main menu contains six Polaroid snap shots that give students access to the contents of site. For example, students click on a "Polaroid" snap shot of a locker to reach a set of learning activities. In contrast, the English site uses the metaphor of a town to portray the site's main menu. On the English site, student activities are found in an Arcade, teacher materials are found in the school and parent materials in houses along the main street. The visual look of the site is also very different from the French site. The English look is light and whimsical.

The finished curriculum materials will be piloted in the province of New Brunswick and then made available to schools across Canada throughout the fall of 1999. Considerable time and effort was also spent working with teachers and government officials to ensure the learning materials met the province's curriculum standards and could be used easily by teachers and students. All project stakeholders have been have been consulted frequently during the design process. A sequenced, phased evaluation design has also been developed by both the French- and English-language teams that incorporates bench-marking knowledge, attitudes, skills and behavior in an experimental research design. Teacher and student reactions to the materials will also be examined.

References

Grabinger, R. S. (1996) Rich environments for active learning. In Handbook of Research For Educational Communications and Technology, D. H. Jonassen ed. New York: Macmillan.

Reeves, T. C. & Jonassen, D. H. & (1996) Learning with technology: using computers as cognitive tools. In Handbook of Research For Educational Communications and Technology, D. H. Jonassen ed. New York: Macmillan.

Wilson, B. G. (1996) Constructivist Learning Environments: Case Studies in Instructional Design. Englewood Cliffs: Educational Technology Press.

Comparing Computer-based and Text-based Research Writing: a Course Model

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Abstract: Since 1996, several lecturers in the University of California, Santa Barbara, Writing Program, have been teaching an upper-division university-level research course that combines traditional, text-based writing with computer aided research presentation, the latter using World Wide Web pages as tools for developing ideas and supporting materials in a non linear way. Each student chooses a topic area of interest and creates a research project on that topic, using two different formats: an expository essay and a website. At the end of the course, each student writes a final exam comparing the two research presentation methods, discussing the advantages and drawbacks of each. Through comparing these two very different approaches to writing, students learn to appreciate the strengths and limitations of traditional academic discourse and Web-based writing and researching.

All of the University of California at Santa Barbara Writing Program's intermediate-level research courses make use of computer technology, but most use it to a limited degree. Listed in the general catalog as "Special Topics in Writing: intermediate writing course with emphasis on critical analysis, exposition, argument and university-level research," these courses are required for graduation in most majors and are designed to provide students with expository writing and research skills that will enable them to develop and present research across a range of academic disciplines. It is expected that, as they complete the requirements for this course, students will increase their competence in identifying and critically evaluating information and in accessing the most relevant sources through computerized library databases and the internet, personal interviews and surveys, and any other measurement instruments they care to design. Students also refine argumentative writing skills, particularly in relation to effectively incorporating research into their writing while maintaining a clear stance and distinct academic voice.

The Writing 50 course described in these conference proceedings builds upon the above-described "typical" Writing 50 course in that it is grounded on an additional underlying principle: namely, that information skills—finding research material via electronic means, reading that material, analyzing it, interpreting it, applying it, and transmitting it in a variety of computer-driven forms—are the foundation for successfully participating in post-millennial academia. As David Victor asserts in a recent article, "We are in the midst of an information revolution unmatched since the invention of the printing press. It is my contention that, just as printed publications gave birth to the institution of the university as it currently exists, the new information technologies are opening a doorway to a new form of institution for higher education" (Victor, 1999, p. 75). The challenge in designing this course, then, lies in taking the pedagogical spirit articulated by Victor and others (Conlon, 1997, Gorman, 1994, Hawes, 1998, Kenny, 1998) and giving it practical shape: creating a course that embraces computer technology as an increasingly important component of the writing and researching processes while meeting the requirements of an intermediate-level research writing course.

Toward that end, the Writing 50 course under consideration devotes equal time to traditional exposition and electronic communication theory and practice. Each student chooses a topic area of interest and creates a research project on that topic, using two different formats: an expository essay and a World Wide Web site. In the expository portion of the course, students learn and practice research skills that enable them to develop and present research in across a range of academic disciplines. They develop increased competence in identifying and evaluating information and in accessing the most relevant sources from the vast amounts of data available through the computerized library databases, the Web, along with first-hand sources such as personal interviews and surveys. During this portion of the course, the instructor covers specific techniques for finding and evaluating researched information and addresses issues of audience, persuasive purpose, argument: rhetorical concepts which assist students in keeping their thesis statements in focus, in maintaining conscious control over tone, and in construct academic research essays logically and persuasively.

In the Web-based portion of the course, students meet in the university's Instructional Computing (IC) facility, where they explore concerns central to creating documents for the World Wide Web, and where they learn skills—including HTML authoring, Web design, and graphics production—necessary to presenting research material electronically. Weekly class time in the IC lab is devoted to assisting students in working on Web pages, using Adobe PageMill as an HTML authoring program. Inevitably, one or two computer science majors will show up in the course and express an interest in learning HTML and/or Java programming languages, because of the greater design flexibility inherent in writing raw code, and/or because they want a programming challenge. These students often become in-class mentors to those students who insist at the beginning of the quarter that "computers hate me." As regards the latter, one of this course's main goals is simple but crucial: to ensure that those students who enter the class as card-carrying technophobes leave the class feeling less antipathy toward technology ... if not wildly enthusiastic about computers, then at least a bit more confident in using computers as a composition and research aid. One student said in an e-mail at the end of last quarter, "Here is my website address ... It was a good idea to have us do this. I feel much less computer illiterate. Thanks so much!" Such unsolicited expressions are especially gratifying, since they validate Young's theory that learning Web page construction skills helps students achieve the computer literacy that the college guarantees them (Young, 1997, p. A25).

At the end of the course, each student writes a final exam comparing text-based and hypermedia-based research presentation methods, discussing the advantages and drawbacks of each. This assignment begins with the statement, "Rhetoric is the art of writing effectively and persuasively. Different modes of rhetoric serve specific purposes and appeal to certain audiences. An ad for Dial deodorant soap, for example, has a purpose—to sell lots of soap—and a target audience: anyone who smells bad, or thinks he or she smells bad. This in-class writing assignment asks you to consider the virtues and drawbacks of two rhetorical formats: the academic research essay and the World Wide Web page." The prompt asks students to consider the following questions: What are the elements that make academic research papers different from other forms of writing? Similarly, what is a World Wide Web page, and how does it work? What are the advantages of each of these forms of information-presentation? What are the limitations of each? To what sort of audience would an academic research paper appeal? Who would be likely to fall asleep or stop reading such an essay before the end? What audience would appreciate the unique qualities of Web pages? Most importantly, perhaps: who might criticize this electronic form of expression and why?

Having reported on these two modes of writing with some degree of objectivity, the student's next step in this assignment is to talk about her experience with each. What about the computer project and research essay did she like and dislike, and why? How did each format affect the student's style of writing, the kind of information she could present, her ability to organize this material effectively, and her ability to communicate your ideas clearly? In comparing these two very different styles of writing, students often end up reporting that appreciate the value of *both* traditional academic discourse and Web-based writing and researching. They therefore become better equipped to write in a range of styles and formats, and to be more critically active readers of printed and electronic texts.

References

Conlon, M (1997). MOOville: the writing project's own "private Idaho". *Technological Horizons In Education Journal*, 24 [8], 66-69.

Gorman, E. (1994). History comes alive on the little screen. *NEA Today*, 13 [2], 25-29.

Hawes, K. S. (1998). Reading the Internet: conducting research for the virtual classroom. *Journal of Adolescent & Adult Literacy*, 41 [7], 563-566.

Kenny, J. (1998). Digital revolution. *Times Educational Supplement*, [4277], A22-A25.

Victor, D. (1999). Electronic classrooms and virtual publishing: a look beyond the writing Requirement. *Business Communication Quarterly*, 62 [1], 74-78.

Young, J.R. (1997). A new graduation requirement at Kalamazoo: create a web page. *Chronicle of Higher Education*, 43 [37], A23-A26.

Reinventing Electronic Commerce with Multimedia: Early Experiences with MCADE

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Abstract: Electronic commerce has gained popularity and acceptance among Internet users over the past few years. This paper describes how an online shopper's experiences can be enhanced with the aid of multimedia, as well as a brief overview of the MCADE architecture currently under development at GTE Laboratories.

1. Introduction

This paper provides a high level overview of MCADE (Multimedia Commerce Application Development Environment), an ongoing research and development effort in the Distributed Multimedia Applications Group at GTE Laboratories. The overall goal of MCADE is to provide a component-based, easy to use solution for implementing distributed multimedia applications related to electronic commerce. Applications developed using MCADE will enhance an online buyer's shopping experience using other media types such as audio, video, and graphics animation, in addition to traditional text and images. A premise of our approach is that video segments can convey more information to users than plain text, a differentiating factor that could be crucial in deciding whether to purchase the product. It can also benefit the seller as well. To the seller, the use of multimedia could provide a more effective way to influence potential buyers to make a purchase of the product (e.g., TV commercials). Part of our research goal in developing MCADE is to investigate how multimedia can help improve the electronic commerce process -- from the inception of selling a product online to a buyer execution of a purchase order.

2. The MCADE Architecture

The MCADE architecture consists of a number of software components, each of which can be regarded as an agent or an application. The agents are loosely coupled to promote reuse and ease of maintenance. Each agent is developed to perform specific designed task(s), and is not influenced by other agents' actions, unless required by the application. In addition, an agent can serve many applications simultaneously. Agents communicate with each other via messages to perform specific application-oriented tasks. Hence, applications are responsible for issuing these tasks.

The software agents in MCADE include 1) Price Comparison Agent, 2) Video Capture Agent, 3) Video Management Agent, 4) Text-to-Speech Agent, 5) Telephony Agent, and 6) Agent Monitor. The Price Comparison Agent provides support for retrieving price information of a particular product from the Web. The agent is being developed using the WebL scripting language from Compaq Research Lab (formerly Digital Research Lab). [1] (Note: WebL is based on markup algebra and provides a flexible and powerful way of "mining" information from the Web. It also provides a seamless integration to relational databases via ODBC library.) The Price Comparison Agent stores prices of products returned from the Web into a relational database such as Microsoft Access. Applications can then perform SQL queries on the data. In thinking about how to compile a database of pricing information, we identified two approaches. The first approach we considered is to develop the price comparison engine ourselves. The second approach is to rely on other price comparison sites such as *www.mysimon.com*, *www.bottomdollar.com*, and *www.webdata.com*, which have emerged on the Internet over the past few years. We intend to proceed with a variation of the later approach, using WebL to retrieve price comparison data from such sites. The Video Management Agent provides all the necessary record keeping of where all the video segments are stored and on which video servers. It is also capable of uploading and deleting video segments from the video servers. The Video Capture Agent is capable of capturing and digitizing the video into the desired format for streaming from a video server such Microsoft Netshow or RealNetworks G2. The Video Capture Agent also has the ability to start capturing of video segment based on keywords of interest in the video closed-captioning. For example, an application could request the agent to start recording whenever the word "GTE" is mentioned in the CNBC cable channel. Other techniques could be used in lieu of using video closed-captioning, but may not be as accurate, such as using speech recognition technology. The telephony agent provides the ability for an application user to place a POTS call. This is useful for example when the online user needs to talk to a sales representative directly. The Text-to-Speech Agent, as the name implies, converts text to speech. The Text-to-Speech agent can be utilized in many ways. For example, together with the Telephony agent, we can easily implement an application that allows users to call in via POTS to check their emails. The Agent Monitor provides the ability to view message exchanges by all the agents. This is useful for debugging purposes. In the future, we may add other functionalities into the Agent Monitor such as the ability to administer other agents.

The Media Message Bus is the underlying framework that provides the basis by which dynamically binds the agents together. The Media Message Bus concept is modeled from our previous *Orchestrator Service* work, where we implemented a message broadcast and event notifications system using Java. [2] Here, we exploit the JavaSpaces toolkit developed by Sun Microsystems. [3] JavaSpaces provides a suitable platform for supporting distributed object persistence and data exchange, as well as event notifications. With JavaSpaces, the Media Message Bus provides the mechanism for agents to communicate with each other using short control messages. It is also used by applications to send requests (tasks to be performed) to the appropriate agent(s).

3. A Comparative Shopping Example

This section describes the first prototype application we have implemented using MCADE. This prototype is based on content captured from an online cable-shopping channel. The rational for developing such an application is that we envision online retailers would benefit by partnering with Internet Service Providers (ISPs). ISPs would provide the networking know-how and infrastructure to support the bandwidth and latency requirements for multimedia data traffic, as well as high-level subscriber information for use in marketing purposes. This arrangement would enable the online retailers to concentrate on their core businesses, rather than spending valuable resources to manage the network.

With the current implementation, the prototype uses video segment captured from a cable-shopping network. The video segments are then digitized and formatted for streaming using the Microsoft Netshow server. Support for other video servers will be included in the near future. This prototype is a Web-based application that incorporates video streaming, price comparison information, and textual description of the product. The goal is to provide an online buyer additional value that a traditional buyer does not have by purely making a purchase decision based on what he/she sees on the cable-shopping channel. Furthermore, with the assistance of the telephony agent, if needed, the buyer can call a sales representative from the cable-shopping network directly.

We are planning to build a similar prototype, but with real-time video capture and digitization. Price comparison information will also be provided in real-time. In this version, online buyers will be able to purchase a product that is currently showing on the cable network. Nevertheless, there are implementation issues on how to find and aggregate the information such as prices into a database server and display the information to an online buyer in real-time. These issues are currently being investigated.

4. Future Directions

The rationale for an environment like MCADE is to enable prototyping of new application services quickly and efficiently. We envision many electronic commerce-based applications can be developed using MCADE. For example, the auction companies such as Ebay (*www.ebay.com*) and Ubid (*www.ubid.com*) could attract more buyers by enhancing their respective web-sites with video content about the products. We are also currently working of a stock quote application that will alert investors of certain price fluctuations in stock as well as capturing video content, if applicable, related to the stock in question from cable-business channels. Investors will have access to the video segments in addition to the stock quote and report.

5. References

[1] Hannes Marais and Tom Rodeheffer, *Automating the Web with WebL*. In Dr. Dobb's Journal, January 1999.

[2] Yechezkal-Shimon Gutfreund, John Nicol, Russell Sasnett, and Vincent Phuah, *WWWinda: An Orchestration Service for WWW Browser, and Accessories*, The Second International WWW Conference'94.

[3] James Gosling, *JavaSpaces: Innovative Java Technology that Simplifies Distributed Application Development*, White Paper, Sun Microsystems, 1998.

The Evolution of Faculty Development and Course Design at the SUNY Learning Network

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Abstract: This paper describes the creation of a scaleable and replicable faculty development process at the SUNY Learning Network. This comprehensive approach includes: an online faculty resource and information gateway, an asynchronous conference for all developers, an asynchronous faculty orientation, a series of workshops for new faculty, instructional design sessions for returning faculty looking to improve their courses, a developer's handbook, a course template, a faculty helpdesk, online mechanisms for faculty evaluation of SLN services, and an assigned instructional design partner to support faculty development and course design.

The SUNY Learning Network (SLN), with grants from the Alfred P. Sloan Foundation and the SUNY Office Advanced Learning and Information Systems, has built an online, asynchronous learning network for the sixty-four State University of New York campuses. This paper discusses the evolution of the SUNY Learning Network faculty development and course design methodology, the technology used, and processes developed for these purposes.

Stage 1

The purposes of stage one is to get the faculty online as soon as possible, so that technology and access issues are addressed right away. It also serves to familiarize the faculty with the program, the components of the faculty development process, and with our web resources for new faculty.
This stage also introduces new faculty to the SLN online community. It also:

- Provides opportunity to network with other new and experienced faculty.
- Introduces them to the SLN web course interface.
- Gets faculty to take the role of "student."
- Models effective instructional design and moderation of asynchronous discussion.
- Provides an opportunity to participate in asynchronous discussion.

Stage 2

This is the conceptualization stage in the faculty development process. The most important component of stage two is the observation of "live" online courses. Course observation is essential for new faculty for a variety of reasons. It allows new faculty to see what a complete course looks like. They can see how a variety of courses are structured, how each course is unique and defined by the content area and instructor in spite of the use of a template, the wide variety of on online and offline learning activities that make up a wide range of courses, how courses are organized or "chunked" into modules, how learning is evaluated by different instructors, and in addition, the courses for observation allow the new faculty to experience how a course grows and unfolds with active participation by students.

Stage 3

Stage three marks the beginning of the seven-step course design process and begins with the first of three face-to-face trainings for new faculty. At the Introduction workshop faculty are given their user names and passwords to our system, introduced to the course development GroupWare application used by the program including our course template and our email system. During stage three faculty continue to have access to the All Faculty Conference and the courses for observation. In addition, they are given access to the SLN Faculty Center, a password-protected website that builds a personalized web homepage for each faculty person including links to:

- Send and receive personal SLN and Internet email.
- The SLN Faculty HelpDesk.
- Get and submit information such as: submitting course descriptions and materials order information.
- Download the SLN course template database.
- Check SLN program announcements.
- The All Faculty Conference, including live courses for observation, a sample course, and a best practices examples area.
- Access link to the individual's course on the web.

The second face to face training occurs in this stage and generally takes place about a month after the first training giving time for the faculty to do some work in their template. The Instructional Design Intensive brings the faculty back together to discuss instructional design issues in the development of online courses and is specifically designed to address actual questions faculty have in the design of specific learning activities for their courses.

The remainder of stage 3 involves the faculty working on the design and development of their course. The role of the Multimedia Instructional Designer (MID), who is very active in this stage, is to help the faculty develop technically and instructionally robust teaching and learning environments for both instructor and students that are appropriate to the instructor's style of instruction, content area, level of the students, and technology being used.

Stage 4 of the SLN Faculty Development Process begins with the third face to face training. The Teaching-and-Managing-Your-Course workshop marks the transition for faculty from the course development phase to the delivery phase. This training prepares them for students entering their course. Everything from technical issues to what to expect are discussed, demonstrated or addressed. Stage four is the "pilot your course" stage. New faculty and their new courses are closely monitored during the first three-four weeks of the semester by the MID. Weekly check-ins, phone and email communications, and intervention when necessary take place behind the scenes. Faculty are asked to take notes on what is working and what needs improvement as they teach the course to make evaluations and revisions easier the next time they teach the course.

Conclusion

For 98/99 academic year, with 37 of the 64 SUNY campus participating, we supported the development and delivery of 460 courses with over 6,000 enrollments. We are well into the seventh faculty development and course design cycle for the fall of 1999 semester with over two hundred and seventy-five courses "in development," a nearly seven-fold increase in the total number developed in the first two cycles. We expect that we will have over 12,000 student enrollments in the 99/00 academic year and the participation of 42 SUNY campuses.

Answering the Needs of Rural Communities: The Virtual High School of Newfoundland and Labrador

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Abstract: In September of 19[illegible], the first four courses were offered by the Virtual High School of Newfoundland and Labrador. The school was conceived and designed to meet the needs of approximately 80,000 students in this remote Canadian province who live and attend school in small, rural communities whose survival is threatened unless the schools remain competitive with urban schools. This presentation describes the early stages of building the Virtual High School and early assessments by teachers and learners.

The relationship between rural economic development and schooling is clear: people go to live where there are jobs; although most jobs are in cities, there is evidence that people are beginning to return to small communities; their doing so will depend on a number of factors, not the least of which is the availability of services, not the least important of which is schooling.

The move from the industrial to the ICT age has begun to have a profound impact on rural communities. Relative equality of access to education and training combined with a job market that is increasingly independent of place offer new hope for the survival of small, rural communities. The Vista Digital Intranet project is contributing the equality of access for students in rural Newfoundland.

Background

Newfoundland is Canada's newest, least populous and poorest province. Its population of just over half a million is scattered across the province's 402,000 sq. km. While fishing and agriculture were once the mainstays of a vibrant economy, official policy and a once-abundant fishery caused people to abandon agriculture in favor of the fisheries. By the late 1960s, fishing was the only pillar of the economy, and thus when fish stocks were depleted, the province's economic well-being and population began to plummet.

Also in the late 1960s, the provincial government undertook a massive scheme to relocate people from a number of very small remote communities. This was an extremely expensive operation, an emotionally wrenching one for thousands of families, and probably unnecessary given the natural decline in population that the province experienced in subsequent years. The legacy of that experience is strong commitment by government to sustain small communities.

True to David Foot's prediction in *Boom, Bust, and Echo*, migration back to smaller communities has begun. The ICT age has neutralized the variable of location for many jobs, new high-tech cottage industries are sprouting up, and e-commerce is breathing life into small businesses. In order to participate fully in economic recovery, i.e., in order to draw people back from cities to smaller towns, these towns will need not just jobs but services, of which education is arguably the most important since people will not remain in small communities unless they are assured that the schools offer a competitive standard of education. The survival of small, rural schools, then, is paramount to the survival of rural communities. The Government of Newfoundland and Labrador, recognizing this crucial fact, has designated approximately 80 schools as "necessarily existing schools," meaning that they are the recipients of teacher allocations and other funding above the norm for the province. Laudable though it may be, this does nothing to protect the educational quality of the other 180 rural schools across the province, 60 percent of which have (K-12) student populations of fewer than three hundred.

Obviously, rural schools cannot afford to offer the full mandated curriculum. In some cases, to do so would mean that there were more teachers in the school than students and this is obviously not feasible. And yet, more than a skeletal curriculum is needed if students are to compete on an equal basis with their urban peers for university entrance and for jobs that increasingly demand not only a good basic education but a high level of competence in information and communication technologies.

The Virtual High School of Newfoundland and Labrador

The Virtual High School was conceived and designed to meet the needs of approximately 60,000 students in the rural communities in the province. The partners in the project[1] provided the infrastructure and the expertise to create and deliver the first four of the High School's courses, advance-placement mathematics, chemistry, physics and biology. These are courses to which students would not have otherwise had access.

Although we are calling this a "Virtual High School," "virtual" has come to imply asynchronous delivery. In fact, delivery is synchronous with a teacher in one school teaching a class distributed across nine high schools in the district. The courses were prepared to meet the requirements of advance placement courses over a four-month period in the summer of 1998. The development team consisted of four groups, one for each subject, who worked together in a single laboratory. Each team consisted of a teacher seconded from the school district, a recent university graduate from the appropriate discipline, and a graduate student in the Faculty of Education. A project manager, technicians and other multi-media consultants were also available to offer assistance. The four teachers who worked on the course development were the same ones who taught the courses when they were offered for the first time in September of 1998.

Class sizes averaged 10, physics being the most popular with 13 students. Teachers worked from specially equipped rooms in the schools with which they were affiliated. Because all nine high schools were located in the same district, potential scheduling problems were avoided. Teachers treated the distributed class like any other, making themselves available, for example, for after-school on-line help sessions. After the first few weeks when technical problems were sorted out and participants became used to the new mode of instruction, students and teachers responded very favorably. There was one exception. In a school with a large cohort of students requesting advance-placement mathematics, a teacher not involved in the project wanted to teach the course in a traditional manner. The District Director had already made the decision to offer all AP courses through the Virtual High School and declined the teacher's request. Unhappy with the decision, the teacher raised doubts in the minds of both parents and students about the quality of instruction they would receive. The Director stood firm, however, and with the intervention of the school principal, parents and students were eventually calmed and persuaded to continue with the course.

When the school year ended in late June, students took the standardized tests in the AP subjects. At this writing, those results are not yet available, but there are other outcomes to be reported:

1. Retention rates were about the same as for AP courses offered in the traditional way;
2. Although there is no hard data to support the observation, teachers believed that the demands on their time were greater than with a traditional class;
3. Although the project used two-way video, once the instructor had the class underway, students usually turned off the "talking head" and made more use of graphics.
4. The students and teachers used e-mail as a supplemental mode of communication outside class hours.
5. Student satisfaction remained high at the end of the course.
6. District officials were generally pleased with the first year offerings of the Virtual High School.
7. Although expensive, the delivery costs were less, even including equipment costs, than the cost of delivering four courses to relatively few students in nine high schools spread over a vast geographical region.
8. Professional development for *all* teachers in the receiving schools is essential to success.

Next year, the Virtual High School adds two new subjects, Global Issues (social studies) and Art Technology. At the same time, Memorial University has developed a diploma in Rural Education and TeleLearning to assist teachers in coping with this project and with others that are certain to emerge as ICT continues to have a major and positive impact on rural schools and rural economies.

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[1] The Virtual High School is funded by a consortium of partners, chief of which is Industry Canada. Their hope is to make these and other high school courses available across Canada on their national network, SchoolNet. Evaluation and some equipment costs are supported by the National Centre's of Excellence TeleLearning Project. The Vista School District and Memorial University's Centre for TeleLearning and Rural Education contribute space, expertise, and some equipment costs, and the entire project is made possible by the pioneering work of STEM~Net, the provincial educational computer network that has had all schools in the province connected since 1994.

Evolving from Face-to-face to Online Teaching for Large Student Groups: Phase 3, Restructuring in a Computer Based Student/Subject Management System.

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Abstract: This paper discusses the third phase in the development of an online subject. The first phase may be described as traditional lecturing, the second as using html code to provide resources on the WWW, the third as utilising a computer based student/subject management system for online support for students (WebCT) and the fourth as the provision of a subject over the web. This paper is written between phases two and three. At the time of writing this paper the lessons learned from the earlier phases are due to be implemented as a program of student support is to be implemented in WebCT. The talk will present the path to fulfillment (or otherwise) of the objectives.

Phase1: Traditional lecturing

Why not go directly to the task of developing a subject for the web? Sheer terror. Like many of my colleagues I (first author) am a good classroom teacher and not overly familiar with the technical aspects involved in delivering on the World Wide Web (WWW). The teaching load during teaching times is such that there can be no technical hitches to solve. In this case development of an online subject was a secondary goal. The primary reason for developing material on the WWW was to provide support in the process of teaching and learning. It was the mechanism to contend with difficulties teaching in the traditional lecturing environment. Principally it was to enhance my ability to teach in a student centred manner, to a class of three hundred students.

Teaching Statistics is a notoriously difficult task. Most of the students undertaking Statistics subjects are compelled to do so. Many students attempt to rote learn feeling that they have little chance of understanding the material. In 1998 the principal co-ordinator set out to adapt and extend her experiential and activity based statistics program developed and successfully trialed in small classrooms (30 students) to the class of three hundred students (STAT131). The aim of this approach was to have students generate ideas upon which the lecture material, statistical theory and processes could be developed. One of the primary benefits of this approach is that students must communicate with the lecturer. It is this communication that guides the lecturer in adapting and modifying the materials in order to respond to student needs whether it is a need for approaching the material from a different perspective or attending to the learning concerns as students encounter work about which they are uncertain. Many students in STAT131 faced the dilemma of whether to take notes or to participate fully. They needed both

Phase2: Using html to provide resources online

During phase 2 lecture activities, student responses and debriefing were mounted on the WWW using html coding. Production was sustained for the seven weeks of session, at which time the task became too onerous, and could not continue without funding and time. (Students were aware that the continued production was dependent upon goodwill and that with other commitments was likely to cease with little notice).

Observations highlighted during the second phase of the development:

• For many students there is a degree of uncertainty and anxiety attached to relying on their own ideas, rather than being able to surface or rote learn from the lecturers notes. To be free to fully participate students needed to be able to re-enact the activities, and to have access to the dialogue that took place in lectures. The resource base developed in the second phase provided a capture of lecture activities and debriefing, some laboratory and tutorial work, past examination papers and subject requirements. This needed to be extended.

• A theme 'what, how and why?' introduced in lectures. This was to extend students' focus from the safety of how to do the sums or draw the graphs to what features of data, theory or concepts would lead to the selection of a particular technique and why the techniques would be revealing, that is interpretive skills. A self and formal 'assessment for learning' system that explicitly taps theoretical and conceptual understanding, technical skills and interpretive skills needed to be developed.

• Use of the online web resources for asynchronous discussion and e-mail enabled students to communicate with each other and the lecturer, providing another source of communication. Students were able to indicate what they needed, whether it was an alternative text or the need to clarify ideas, or to seek extensions.

• Students were responsive to the activities and experiences and wanted these extended to all topics. Attendance rates at lectures remained high. Lecture attendance was associated with higher pass rates on midterm exams. The overall failure rate was approximately 14% lower than the previous year.

Phase 3: Online Support Using a Computer Based Management System.

The objective in the third phase was to develop a comprehensive online resource based teaching and learning support system for Introductory Statistics. The system needed to be easier to establish and maintain than had been the direct use of html on the WWW. For this reason a package, WebCT, which has just been adopted as the University standard, was chosen WebCT is a computer-based system for the management of subjects and student assessment and learning. The system provides a user-friendly interface for students and developers. WebCT in this paper is conceptualized as providing a resource based approach to learning. It will support a traditional lecture subject but has the potential for students to draw heavily upon it to replace some aspects of the traditional subject.

The resource package was to include:

- all lecture activities and debriefs including sound, animation and slide-sound sequences;
- self and formal 'assessment for learning' systems which were to explicitly tap theoretical and conceptual understanding, technical skills and interpretive skills;
- materials suitable for students from a variety of disciplines;
- a glossary of notation which was to be compatible across the department's statistics subjects;
- a pre-test of mathematical skills; materials to review pre-requisite mathematical techniques;
- facilities for online evaluation of the subject, lecturing, learning and online resources;
- communication links such as email, chat and hot links to data sources and relevant statistical sites;
- subject requirements, tutorial and laboratory tasks, past examination papers and solutions.

In a class of three hundred there are many learning styles. Students were to be provided with a mix of experiential, activity based and traditional lecturing. The resource based teaching and learning system whilst targeting specific learning goals (knowing what, how and why) was to provide students with an alternative and/or complementary approaches to learning

Phase 4: Delivery of a Online Subject

This talk will report the experiences of the team, lecturer, educational developer, students and laboratory teachers using a learning resource accessible through the WWW to supplement lectures. It will discuss the challenges of delivering online subjects that use symbolic languages. It will also detail the modifications of the resource base which are necessary in order to replace the face-to-face lecturing component of the subject with an online version for a remote campus.

Formalization and Integration of Scaffolding in a Web-Based Learning Environment

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Abstract: With numerous courses being offered via the WWW, it is important to focus on the design of course content. In this paper we discuss a constructivist, problem based approach in designing web based learning environments which we are using this approach in the design of online courses in the School of education. We discuss the importance of various levels of scaffolding – cognitive, social and metacognitive, to enable students to learn in the problem-based environment.

With the availability of cheap and powerful computers and advances in technology, there are now numerous courses that are being offered to students via the World Wide Web. As reported by LaRose, Gregg and Eastin (1998), over 200 college courses from 100 Universities were available over the internet in 1998. However, with rapid advances in technology and the demand for such courses, pedagogical issues are often being overlooked in the design of web based courses. Most of the courses offered on the WWW are no more than a set of linked pages with a syllabus, a class schedule, lectures in the form of essays or PowerPoint slides, a set of readings on the web or on paper and a set of assignments. Tools such as webCT are now available to make the building of these features less time consuming. However, little attention is being paid to the design of the *course content*. We believe that the design of the course content itself should be learner-centered (Jackson et al. 1998), so that the educational benefits are maximized. Furthermore, decades of research in designing and implementing computer based learning (drawing from fields such as Psychology, AI, HCI, Cognitive Science) can provide the necessary pedagogical foundations for the design of an educationally effective web-based interactive environment for learning.

A constructivist, problem-based framework

In this paper we describe our work (in progress), on designing an introductory course in learning theories as a web-based interactive learning environment. The course is a Graduate course in the school of Education and will be offered next spring after initial testing in this summer and fall. We are organizing the course around a set of complex ill-structured problems. The problems or scenarios that we are choosing for the course are taken from real world learning situations (K-12 and college). Problem solving has long been regarded as a generative activity that could promote deep learning (e.g., Barrows, 1985), and recent research shows that, indeed, students learn content knowledge deeply by solving relatively complex ill-structured problems which can have multiple solutions (Bransford & Stein, 1994).

Such an environment affords rich opportunities for learning. The problems for the course are from the world of practice, from real world learning situations. Each problem needs to be explained in terms of the learning theories (or concepts therein) that students are required to study for the course. As they work on solutions to complex problems, students have the opportunity to construct and generate rich meanings. In addition, students need to reflect on their ideas and solutions, provide explanations and justifications, all of which can augment their understanding of the domain knowledge.

Levels of Scaffolding

An important aspect of making this approach work is the scaffolding that students require in order to successfully negotiate within an ill-structured problem space. Scaffolding in a complex environment such as problem solving needs to be *distributed* among many agents (Puntambekar & Kolodner, 1998). This is because complex problem solving involves many stages and any one agent of scaffolding, such as the teacher or the software cannot provide students with the support and adaptability that scaffolding in such an environment requires. We are designing and implementing three levels of scaffolding: cognitive, social and metacognitive.

Cognitive level

Based on the Vygotskian notion of making abstract processes more visible, the cognitive scaffolding that we are designing provides students with support for the processes or steps in problem solving. This involves helping students to restate the problem, generate ideas about how they might solve the problem, providing a concept map that will help students to become familiar with the vocabulary, and find the necessary information from the resources provided. We are designing concept maps that will serve as scaffolds in the form of the conceptual representation of the theories and concepts that they need to solve the problem. Maps to provide a historical perspective for the theories, which is an objective of the course are also being developed.

Social level

Scaffolding at the social level comes from the electronic discussions that students engage in. Learning in a web-based environment is a truly distributed event because learners are physically removed from one another. Learners can play an important role in supporting each other in the process of learning. They can post ideas, critique each others' ideas and reshape their own, ask questions and provide explanations. Thus numerous ways to reflect and articulate can be built into the environment which enables the individual learner to construct meaning. Research on computer supported collaborative learning suggests that discussions are more fruitful when they are anchored (Guzdial, et al. 1997). In our course, we are designing discussions to serve as scaffolds during at least three stages in problem solving: initial brainstorming, generating ideas to solve the problem, and for explanations and justifications. The instructor plays a major role in mediating these discussions.

Metacognitive level

An important aspect of both these levels is that metacognitive prompts to encourage reflection are embedded in them. Thus, for example, students are provided with prompts that will encourage them to explain any problem from multiple perspectives drawing from concepts from different learning theories, thereby providing them with an opportunity for generating richer understanding and integration of theories.

Integration of the multiple levels of scaffolding

Although we have described three different levels of scaffolding, they are not mutually exclusive and we need to align all the affordances so that they are well-integrated and taken advantage of. We are integrating the levels in such a way that in the initial stages of the problem, the instructor plays a major role in providing the cognitive scaffolding. Thereupon, the learner-learner interaction becomes more prominent with the learner asking questions and providing answers and justifications. The metacognitive scaffolding is embedded in both these levels by having the students reflect upon and articulate their problem solving experiences.

References

Barrows, H. S. (1985). How to design a problem based curriculum for the preclinical years. Springer-Verlag, NY.

Bransford, J D. & Stein, B. S. (1993). The ideal problem solver. W. H. Freeman: New York.

Guzdial, M., C. Hmelo, et al. (1997). Integrating and Guiding Collaboration: Lessons learned in computer-supported collaboration learning research at Georgia Tech. CSCL'97. Toronto, Ontario. 91-100.

Jackson, S. L., Krajcik, J., Soloway, E. (1998). The Design of Guided Learner-Adaptable Scaffolding in Interactive Learning Environments. Presented at CHI 1998.

LaRose, R., Gregg, J., & Eastin, M. (1998). Audiographic telecourses for the web: An experiment. In Journal of computer mediated communication, Vol. 4 (2), http://www.ascusc.org/jcmc/vol4/issue2/larose.html.

Puntambekar, S. & Kolodner, J. L. Distributed scaffolding: Helping students learn in a learning by design environment. In A. S. Bruckman, M. Guzdial, J. L. Kolodner, & A. Ram (Eds.), *ICLS 1998, Proceedings of the International Conference of the Learning Sciences*, pp. 35-41.

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A Web site does not a community make

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Abstract: The paper describes a system to support student collaborative and metacognitive activities in distance education settings, called an *education recommender system*. This Internet-accessible system allows students to share and view ratings, opinions, and recommendations about resources on the Internet and World-Wide Web based on a social information filtering system. We believe that this approach promotes more mindful and reflective engagement with Internet-based information. Use of the system also helps support collaborative and community-building learning activities in a distance learning setting.

1. Introduction

Recent government initiatives, paired with changing education policies and the falling cost of hardware have prompted a huge influx of information technology into the classroom. Beyond the traditional tutorials and drill and practice programs, many classrooms are placing a great deal of emphasis on the use of the Internet and the World Wide Web for teaching and learning. Teachers hunt the WWW for instructional resources, while students use the web to communicate with pen pals, research topics, and share information. Yet, while much money and effort has been expended the networking infrastructure of the WWW, considerably fewer resources have been spent on developing pedagogically appropriate models in the context of ubiquitous – but unstructured-- digital information. Rather than providing access to instructionally sound, validated, and edited resources, the web merely represents the information delivery truck, ready to unload its cargo without any assurance of consumer satisfaction. This emphasis on "access to information" has led to a "copy-and paste" generation of learners. Learners accessing the web have no resources for judging the accuracy of data, the usefulness or currency of the information, or identifying the context for which the information was intended. Furthermore, there is no infrastructure to facilitate learning; instead information is merely presented to the learner in a "take it or leave" context. If educators are going to harness the educational utility of the Internet, researchers need to begin to examine methods that support structuring information in a meaningful way, and promote engagement of the learners with the content and with each other. In this paper, we describe and discuss an information architecture that promotes more mindful and reflective engagement with Internet-based information. We argue that this approach leads to collaborative sense-making of digital documents in a way that is relevant to the needs and goals of particular classrooms and settings.

2. Recommender Systems

The explosive increase in the number of World-Wide Web resources has exacerbated the problem of finding relevant, quality, and validated information. Since the Web supports unstructured information access, there are few mechanisms in place to aid in the collection and evaluation of filtered information for particular community purposes. There are, of course, the commercial search engines (e.g., Infoseek, Snap) which filter information based on key content concepts. There are also compiled lists of URL addresses related to a particular topic (e.g., Yahoo). Both of these filtering systems focus on content while neglecting the utility, quality or relevance of the information contained within them for a particular community of users. Within the human-computer interaction (HCI) literature, a new paradigm of categorizing, collecting and filtering information, called "social information filtering," has emerged. This approach is based on propagating word-of-mouth opinions and recommendations from trusted sources. As proposed by many, it holds promise for the adding structure to the Web [Shardanand & Maes, 1995].

3. Educational Applications

Projects implementing social information filters have been demonstrated in a variety of areas from music recommendations to Usenet groups. Yet to date, these systems have been fairly constrained in their intent, audience and utility. We believe that more highly evolved systems have the potential to become powerful educational tools. As we will argue, these are tools that help to develop, define, and nurture communities of learners.

In our project, we currently are developing a system that will allow learners and teachers to share ratings, opinions, and recommendations about content on the Internet and Web, using an existing index of Internet-based learning resources (e.g., www.TeacherLink.usu.edu). Through using our system, users will be able to access the recommendations of other users (called metadata) in order to help them locate quality information, and avoid wasteful sites. Users can also contribute opinions about sites that they visit. These metadata, in turn, become part of the recommendation database. The development of our recommender system is guided by several issues important both from educational and technological standpoints. First, we note that contributors to the recommendation database form a community. Information about who contribute opinions is as important as the contribution itself. Second, because contributors form a community, they have their own language and set of values. Hence users must be able to create and modify the representational vocabulary of the metadata. Third, evaluating information sources and contributing ratings is a metacognitive activity. Engaging in such tasks forms an important learning goal in a knowledge society. Nonetheless, it must not add an undue cognitive load, or users will ignore the tool. Finally, a critical mass of users must participate to ensure rating reliability and validity. This suggests that use of the tool must be embedded in tasks and activity that are authentic and relevant to the particular community.

Our approach complements recent results from educational research, which calls for a shift from teacher-oriented, didactic classroom strategies to learning environments that are focused on students' engagement and knowledge ownership. Such approaches focus on creating a "community of learning." Within a community of learning, understanding arises from group consensus, rather than from individual fact finding. Each member of the community has a particular expertise that is brought to bear on problems being solved by the collective, and it is with the advancement of the entire group's understanding that learning is pursued [Brown and Campione, 1990].

4. References

[Brown and Campione, 1990] Brown, A. & Campione, J. (1990). Communities of learning and thinking, or a context by any other name. Human Development, 21, 108-125.

[Shardanand & Maes, 1995] Shardanand, U. & Maes, P. (1995). Social information filtering: Algorithms for automating word-of-mouth. *ACM Conference on Human Factors in Computing Systems* (pp 210-215). New York, NY: ACM.

We're Wired – Get Connected!
A District Model for Web-Centric Educational Services

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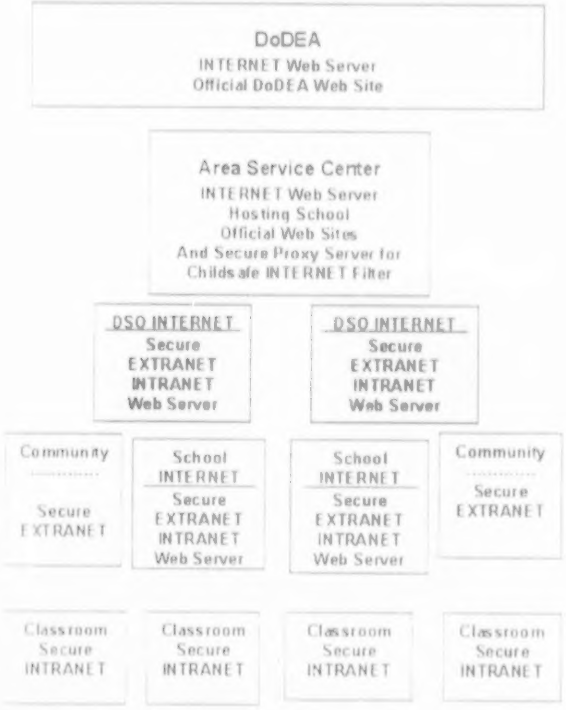
The Brussels District Schools are part of the US Department of Defense Dependents Education Activity (DoDEA) serving the children of US Military and Civilians working outside of the continental United States. By early 1999, the District had implemented INTERNET Connectivity in all 13 of its Elementary, Middle and High Schools located throughout Belgium, the Netherlands and Germany. Additionally, school-wide Local Area Networks with 8 drops per classroom had been installed in more than half of the schools, with plans to wire the remaining schools well underway. The challenge facing the District was to build a program based on a system-wide consensus that would assure the educational utilization of these resources by the entire "Learning Community" of students, teachers, administrators, parents and other community members. The foundation for this program would be the President's Technology Literacy Challenge comprised of Four C's (Computers, Connectivity, Competencies and Curriculum) and the DoDEA Technology Plan. See http://www.whitehouse.gov/WH/EOP/OP/edtech/ and http://www.odedodea.edu.

As a result of extensive interviews, surveys, meetings and workshops, the Brussels District has begun to develop and implement the following plan, which envisions a hierarchical Web structure (See Graphic) comprised of sites on an INTRANET, an EXTRANET and the INTERNET.


DoDEA
INTERNET Web Server
Official DoDEA Web Site
Area Service Center
INTERNET Web Server
Hosting School
Official Web Sites
And Secure Proxy Server for
Childsafe INTERNET Filter
DSO INTERNET
Secure
EXTRANET
INTRANET
Web Server
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The INTRANET Site will be accessible on the School Local Area Network only, and it will focus on "Electronic Portfolios," "Collaborative Workspaces," and "Multi-media Showcases." The EXTRANET Site will provide remote secure access by id and password to the school INTRANET Web Site for authorized District Community Members. Finally, the INTERNET Web Site will be the "Official School Web Site" accessible to all, and featuring public information as well as "Exemplary Student Work".

Current Status of Web Server Implementation in Brussels District – July 1999

The Brussels District has been operating an "official" web server for 15 months (March 1998) at the following URL:

(http://www.brus-dso.odedodea.edu)

This server functions as the "official" web site for district business as well as hosting the web pages for all 13 of its schools. Teachers have been trained to serve as webmasters for their school, and they receive "extra duty pay" for their work with the local Web Team. All schools have complete autonomy in publishing and managing content on their web site.

The conference presentation will demonstrate the preliminary results of this district model for web-centric education with examples from the First Phase of the Project concentrating on the schools INTERNET and EXTRANET Web Sites.

AFCENT International School (The Netherlands)
http://www.brus-dso.odedodea.edu/schools/afcenths/index.htm

Bitburg ES Technology Program (Germany)
http://www.brus-dso.odedodea.edu/schools/bites/comp.htm

Geilenkirchen ES, Lunch Program and EXTRANET (Germany)
http://www.brus-dso.odedodea.edu/schools/gkes/lunchmenu.htm
http://www.brus-dso.odedodea.edu/schools/gkes/i-classrooms.html

Brussels American School, Math (Belgium)
http://www.brus-dso.odedodea.edu/schools/bas/mathdept.html

Phase Two of the District Web Plan will begin in August 1999 with the installation of new INTRANET Web and Proxy Servers in 4 schools. New INTRANET Webmaster positions have been created which will provide on-going training and support. Finally, new CD-ROM Writers and Digital Cameras will be provided to encourage a creative approach to student-centered multimedia production.

The entire plan is online at the following URL:

http://www.brus-dso.odedodea.edu/webconf/webplan1.html

Techniques for Promoting Participation and Ownership for Learning in Web-based Instruction among In-service Teachers

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Abstract

In distance education, instructors often need to guide and enhance the transition from a traditional model of pedagogy in which the learners' role is passive, to a model in which students take a full, active role in directing their own learning. This paper describes techniques for using web-based instruction to promote student participation and ownership in learning in three important areas: moving learners from passive participation to active participation, moving learners from instructor-directed tasks to self-driven tasks, and moving learners from non-evaluative sharing to true collaboration.

Introduction

One day, a prospective student was speaking to us about our distance learning program, and we were pointing out the advantages it offered for her, as she could save an hour-long commute to the campus-based classes. "Oh, no," was her final reply, "I don't think I would like that. I want to be able to see the teacher."

It is easy for those versed in computer technology to overlook the very foreignness that can confront learners taking their first class using web-based instruction, especially if this instruction is provided at a distance. The absence of a live instructor, the strangeness of the presentation format, the different roles demanded of students are factors that can create a significant level of anxiety and discomfort in students more used to the conditions of traditional classroom instruction [Foegen, Howe, Deno & Robinson 1998].

Studies show that highly motivated learners are the most likely to benefit from distance education [Riddle, 1994; Wagner & McCombs 1995]. But to be effective, distance education needs to reach out to average students who may not be comfortable with the demands of web-based instruction [Knapczyk, Rodes & Chung 1998]. In our program we have found that the solution to this problem lies not in communicating clearer expectations for the way our courses are structured, but in shifting the learners' own expectations for what their roles and experiences in the classes can and should be. We have thus come to view instructional development for distance education not so much as a matter of setting standards and practices, but rather a matter of defining a process that increases students' comfort level and involvement in web-based instruction. This process leads students from their initial expectations of teacher-centered, passive instruction to adopting a more learner-centered, collaborative model which gives them ownership and direction over their own instruction [Knapczyk et al. 1998].

Background: The Collaborative Teacher Education Program

For the last thirteen years the Collaborative Teacher Education Program at Indiana University (CTEP) has been offering continuing education courses by distance education to teachers in rural communities [Knapczyk & Rodes 1995; Knapczyk et al. 1998]. Participants in our courses are teachers, administrators, and other in-service professionals in rural communities who have difficulty accessing coursework in traditional campus-based settings. In addition to attending weekly classes via videoconferencing, the students share their work and discuss course content using web-based conferencing and e-mail.

Techniques for shifting from instructor-centered learning toward student-centered learning

The approaches we have developed in our classes recognize that students are likely to be unfamiliar with the course delivery format for the first few class sessions, and that they will feel overwhelmed if we expect them to show the level of independence and activity in the beginning of a course that we hope to build in them by the end. Therefore, we have learned to view our role from the start as promoting or facilitating a shift toward greater student participation and ownership of their own learning. Web conferencing, with its capabilities for student collaboration and independence, is a significant tool for bringing about this shift [Knapczyk et al. 1998]. Through our use of AVF and the other components of our distance education technology, we promote learner-centered instruction in three main areas: participation, course tasks, and student collaboration.

Techniques for moving learners from passive participation to active participation.

Much of the success of distance education rests on encouraging an active role for learners [Risenberg & Zimmerman 1992; Spooner et al. 1998]. Students must learn to rely on themselves not only to access and master technology, but also to make up for the range of subtle directions, cues and information that they are used to receiving from live instructors. Both in class meetings and on the web, we encourage an active role for learners. But students coming into our classes are typically used to a more passive format of instruction. We have found that students respond indifferently to many of our initiatives if we present them too early in the semester, and that patterns of independence and ownership must be built gradually in them rather than thrust upon them suddenly.

Accordingly, we begin our courses with a more traditional, teacher-centered approach, and proceed toward a more learner-centered model as the students become familiar and comfortable with the distance education format and technology. When class first begins, we do not require a strongly active participation. We ask for volunteer coordinators, but lead discussions ourselves. We encourage student input, but give them time to script their answers. We follow this same pattern in our use of web technology. Early in the semester, we rely heavily on e-mail to communicate with students between classes. Their contact with us is typically one-sided, and our responses are detailed and individualized. As the semester progresses, we begin demanding more of their contributions. We move more class activities to AVF, so that their web-based communication becomes an integral part of the class.

Techniques for moving learners from instructor-directed tasks to self-driven tasks.

In the past we started off a course giving students very liberal reign in the types of responses they made on the web forums. Our reasoning was that we wanted to use this learner-centered technology to build independence. What we found instead was that responses were short, sporadic and aimless, and that students saw the web technology as an extra chore rather than as a space for meaningful work.

To remedy this problem, we now begin the semester with very specific activities that students carry out on the web. The content of these activities is deliberately kept simple so we have tight control over the learning that takes place. As the semester continues, we build in elements to make the assignments increasingly individualized and independent. By completing web assignments that are increasingly shaped by real world demands and considerations, students can take on more and more responsibility for their work with minimal management and oversight by instructors [Honebein, Duffy, & Fishman 1990].

Techniques for moving learners from non-evaluative sharing to true collaboration.

Perhaps the most important element of developing learner-centered instruction is building collegiality and collaboration among students to take the place of instructor direction [Friend & Cook 1993; Slavin 1990]. Through careful nurturing of teams and teamwork, we are able to encourage students by the end of the semester to take on many of the roles they would normally expect campus-based instructors to fulfill.

We first began using web instruction in our courses to encourage students to give each other support and advice about their work. This is particularly desirable when working in such professional development fields as teacher education, as the learners typically have a wealth of experience and expertise to share that goes well beyond what instructors can provide. But we found in actual web-based discussions that teachers were reluctant to offer genuine critical assessments of their peers' work, and that most of the interaction was cursory or off-topic.

Accordingly, we have learned to progress toward real collaboration by beginning with simple opportunities to share information and gradually including opportunities for real contributions to and critiques of peer work. We start the semester with simple sharing of work samples, exchanging basic information, and describing school situations and personal experiences. As the students familiarity with one another increases, we ask them to offer examples or suggestions based on their peers' work, rather than their own. By the end of the semester, we expect them to give full-fledged support and critiques of one another's projects.

Conclusion

In order for distance education to be effective, instructional planning must consider the gap between the typical student's expectations about the learning process and the capabilities and characteristics of instruction over distance. Careful, gradual introduction of web-based technologies can guide and enhance the learners' transition from a traditional model of pedagogy in which their role is passive, to a model in which they take a full, active role in directing and achieving their own learning.

References

Foegen, A., Howe, K., Deno, S., & Robinson, S. (1998). Enhancing the potential of distance education: A case study involving groupware. Teacher Education and Special Education. 21. 132-149.

Friend, M. & Cook, L. (1992). Interactions: Collaboration Skills for School Professionals. New York: Longman.

Honebein, P. Duffy, T.M., & Fishman, B. (1993). Constructivism and the design of learning environments: Context and authentic activities for learning. (In T.M. Duffy, J. Loweyk and D. Jonassen (Eds.). Designing environments for constructivist learning. Heidelburg: Springer-Verlag.

Knapczyk, D. & Rodes. P. (1995). Effecting change in-service teachers through distance education. Technology and Teacher Education. 3. 47-55.

Knapczyk, D., Rodes, P. & Chung, H. (1998). Collaborative learning program address demand for special education teachers. Technical Horizons in Education Journal. 26. 57-60.

Riddle, J.F. (1994). Factors contributing to achievement and course satisfaction of distance education students. Greeley,CO: University of Northern Colorado. Unpublished doctoral dissertation.

Slavin, R. (1990). Cooperative learning: Theory, research and practice. Englewood Cliffs, NJ: Prentice Hall.

Spooner, F., Spooner, M., Algozzine, B., & Jordan, L. (1998). Distance education and special education: Promises, practices and potential pitfalls. Teacher Education and Special Education. 21. 121-131.

Wagner, E.D. & McCombs, B.L. (1995). Learner centered psychological principles in practice: Designs for distance education. Educational Technology. March-April. 32-35.

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How Does Achievement Differ in Comparing Learning By Distance to Learning On-Campus: A Preliminary Analysis

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Methodology

Research Question

Does student achievement differ in comparing conventional and web-based course environments?

Overview of Procedure

In the winter of 1999, the University of Calgary's Community Rehabilitation program offered the undergraduate half-course, *Law and Disability*, fully on-line via the World Wide Web to students across Western Canada. At the same time, a group of on-campus students at the university were enrolled in a conventional version of the same course. Both the on-line and conventional courses were taught by the same instructor who is a practicing lawyer and experienced sessional instructor with the Community Rehabilitation program.

The course web site was carefully constructed to provide students with many of the same learning opportunities provided to on-campus students. For example, the instructor placed lecture summaries on-line in addition to other content that was covered in the conventional classroom. In this way, students in both groups had similar exposure to *course content*, and thus, valid assessment of learning outcomes between groups could be made.

Insofar as the web has tremendous potential to enrich student learning experiences, it was difficult to equalize the treatments in both groups. While each group had one instructor-led lecture conducted per week and were given the same notes, assignments and examinations, the on-line group had a number of supplemental resources and tools. Because this study's goal was to compare directly the nature of learning on-line and face-to-face maximizing the resources afforded by the Web was essential.

The web site learning environment adhered to most features included in the distance education course creation checklist created and published by Ross [1998], and was deemed instructionally sound by a focus group of five students and two learning technologists.

Instruments

To validly assess learning outcomes, a 40-question multiple choice examinations was administered to participants at the beginning and the end of the course.

Subjects

A convenient sampling method was used for the purposes of the study. Thirty-eight students enrolled in the on-campus version participated in the study, while 36 web-based course learners chose to participate in the study.

Independent Measures

Treatment Group—Two groups: 'By Distance' and 'On-Campus' were examined for the purpose of this study.

Dependent Measures

Learning Outcome-- Achievement levels were measured by students' post-test score as measured by a 40-question multiple choice examination and by students' final course grade recorded.

Results

Analysis of covariance (with significance set at the $p < 0.05$ level) was performed on the 2 subject groups: 'On-Campus' and 'By Distance' using post-test scores as the dependent variable and pre-test scores as the covariate. The hypothesis of equal slopes was accepted(F[1,74]=8.25, p=0.137) and that of zero slope was rejected (F[1,74]=8.74, p=0.005) which indicates that ANCOVA was an appropriate model for data analysis.

Controlling for pretest, there was significant group effect on post-test scores (F[2,72]=4.17, p=0.019).

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	204.27	72	2.84		
REGRESSION	.03	1	.03	.01	.916
CAMPUS	23.55	1	23.55	8.30	.005
(Model)	23.68	2	11.84	4.17	.019
(Total)	227.95	74	3.08		

Ancova results revealed that the 'By Distance' group performed significantly better on the 40-question post-test than did the 'On-Campus' group. Descriptive information indicated that the 'By Distance' group recorded a final mean score of 35.2 while the 'On-Campus' group obtained a final exam average of 33.4.

Discussion and Conclusion

This study sought to compare student achievement in a course taught on campus and by distance. Preliminary results found that when controlling for pre-test knowledge disparities, the 'By Distance' group performed significantly better on the 40-question multiple choice test than did the 'On-Campus' group. Mean averages differed by almost two points. It would appear that, in this instance, off-campus students were more successful in demonstrating their course knowledge than students who took the same course on-campus.

This study illustrates the potential power of the Web to support learning if the instructional environment is structured according to instructional design principles as outlined by Ross [1998].

Future Analysis

Future research questions to be explored as part of my dissertation include:

1. How does learning style (as measured by the Gregorc Style Delineator) relate to achievement and attitudes towards the course, instructor and learning medium?
2. Are there differences in:
    - Student-student interaction;
    - Student-instructor interaction; and
    - The amount of time (in hours) spent on course-related learning?
3. What are some of the characteristics of on and off-campus student learners?

References

[Ross, 1998] Ross, J.L. (1998). On-line but off course: A wish list for distance educators. *International Journal of Leadership in Learning,* 2(1), [on-line] http: www.ucalgary.ca/~iejll.

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Normative Influence and Emotionality throughout Web based discussion

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Abstract: An important feature of Computer-mediated Communication (CMC), compared to other modes of communication, is anonymity of its users. Two theories comparing anonymous and identifiable behaviour during CMC are discussed. An experiment is conducted to test the Social Identity Model of DEindividuation (SIDE, Spears & Lea, 1992).

1. Introduction

An important feature of computer-mediated communication (CMC), compared to other modes of communication, is anonymity of its users. Some researchers studying CMC believe that this anonymity accounts for an impersonal interaction with others, and therefore responsible for a diminishing in social influence during CMC (e.g. Kiesler, Siegel, & McGuire, 1984). Furthermore, because of the interpersonal form of interaction, emotionality (the term used to indicate the expression of emotion) is highly reduced, therefore CMC users are expected to perform communication styles, which are mainly task oriented. Some other experiments showed that anonymity could also lead to an increase of social influence within a group (Postmes, 1997; Spears, Lea, & Lee, 1990). An explanation for these findings is provided by the Social Identity model of DEïndividuation (SIDE-model; Spears & Lea, 1992). The SIDE model derives from Social Identity theory and it's practical implications on mass behaviour (Reicher, 1984). The Social Identity theory notices that the self encompasses a scope of possible social identities, ranging from individual identity to group identity (Tajfel & Turner, 1986). Anonymity can strengthen group behaviour when the perceived social identity of the group is strong. It is the appropriate social identity, which allows anonymous group members to fully express behaviour according to the norms and rules of the social group they belong to.

The aim of the present study is therefore twofold, first a group norm is manipulated, CMC users communicate either using a task- or an emotional-oriented groupnorm and secondly the context in which the groups discuss is manipulated; CMC users are either anonymous or identifiable for each other.

2. Method

Seventy-five subjects were randomly divided into 21 groups of three (nine groups) or four (12 groups) persons. All participants were then directed to an isolated cubicle with the instruction to start with the experiment which included the group manipulation (Doosje, Ellemers, & Spears, 1995). At the end of the discussion subjects were asked to fill out a questionnaire.

3. Results

All analyses were conducted at the group level. The content was coded using Bales' "interaction process analysis" (IPA) coding scheme (Bales, 1950). Compared to identifiable groups, the anonymous socio-emotionally activated groups suggested more socio-emotional solutions ($M = 3.49$) and anonymous task-oriented primed groups favoured more task-oriented solutions ($M = 2.30$) for the problem, and simple main effects indicated this to be a significant difference, $F(1, 17) = 9.59$, $p < .01$. In the individual solutions for the presented dilemma (open question on the questionnaire) there were no significant main effects. The expected interaction anonymity and priming however was highly significant, ($F(1,17) = 11.93$, $p < .01$).

Table 1: Mean score (Standard Deviation) on some dependent variables.

	Anonymous		Identifiable	
	Socio-emotional *n* = 6	Task-oriented *n* = 5	Socio-emotional *n* = 5	Task-oriented *n* = 5
Individual solutions†	3.49^{a} (0.28)	2.30^{b} (0.87)	2.25^{b} (0.71)	3.02^{ab} (0.65)
Number of empathic words	3.20^{a} (1.65)	2.33^{ab} (1.33)	1.37^{b} (1.12)	3.15^{ab} (1.23)
Number of task-oriented words	3.23^{ab} (1.69)	5.16^{ab} (2.80)	5.97^{a} (1.98)	3.12^{b} (0.92)
Development of solutions in time†	$.13^{a}$ (0.25)	$-.11^{b}$ (0.42)	$-.22^{b}$ (0.36)	$.14^{a}$ (0.13)

†Higher scores indicate more empathic solutions, individually or in time.
Means in row with different superscript differ significally, $p < .05$.

Interestingly, the regression coefficients did show a significant interaction in the predicted direction, $F(1, 17) = 5.06$, $p < .04$, $MSE = 0.09$. Across time, the anonymous socio-emotional groups suggested more socio-emotional solutions ($M = .13$, higher scores indicating more socio-emotional solutions over time) compared to the identifiable socio-emotional groups ($M = -.22$). The anonymous task-oriented groups however proposed solutions that became increasingly task-oriented ($M = -.11$), while the identifiable task-oriented groups became more socio-emotional in their solutions, although the difference failed to reach significance ($M = .14$, $F(1, 17) = 1.71$, $p = .20$).

4. Discussion

The reported experiment set out to demonstrate that anonymity in a group could lead to enhanced normative behaviour. Results show that anonymous groups choose solutions to a dilemma that are consistent with the prime, whereas identifiable groups do not. This effect occurs both in the solutions to the problem and in the language used during discussion. Moreover, suggested solutions show a predicted development over time, such that anonymous groups tend to behave more prime-consistent over the process of discussion, whereas identifiable groups behave prime-inconsistent over time. This development of primed behaviour in the course of interaction is reinforced in anonymous groups, whereas it is restrained in the groups where individuals are identifiable. The experiment succeeded in demonstrating that CMC is not necessarily more task-oriented. Rather it was demonstrated that socio-emotional interaction styles are very much possible via CMC.

5. References

Bales, R. F. (1950). Interaction process analysis: A method for the study of small groups. Reading, MA: Addison Wesley.

Doosje, B., Ellemers, N., & Spears, R. (1995). Perceived intragroup variability as a function of group status and identification. Journal of Experimental Social Psychology, 31, 410-436.

Kiesler, S., Siegel, J., & McGuire, T. W. (1984). Social psychological aspects of computer-mediated communication. American Psychologist, 1984, 1123-1134.

Postmes, T. T. (1997). Social influence in computer-mediated groups. Phd Thesis, University of Amsterdam.

Reicher, S. D. (1984). Social influence in the crowd: Attitudinal and behavioural effects of de-individuation in conditions of high and low group salience. Special Issue: Intergroup processes. British Journal of Social Psychology, 23, 341-350.

Spears, R., & Lea, M. (1992). Social influence and the influence of the 'social' in computer-mediated communication. In M. Lea (Ed.), Contexts of Computer-Mediated Communication (pp. 30-65). Hemel Hempstead: Harvester Wheatsheaf.

Spears, R., Lea, M., & Lee, S. (1990). De-individuation and group polarization in computer-mediated communication. British Journal of Social Psychology, 29, 121-134.

Tajfel, H., & Turner, J. C. (1986). The social identity theory of intergroup behavior. In S. Worchel & W. G. Austin (Eds.), The psychology of intergroup relations (2nd edition). Chicago: Nelson-Hall.

Surfing in the Web: an Experience of the Use of Internet in Educational Process

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Abstract: The Internet has changed the process of communication in these years. The net or cyberspace provides much useful information as we navigate URL's, browsers and hyperlinks. The explosive growth of the Internet and the convergence of information and communications technology is opening up new educational opportunities. The Internet can be used to modify the teaching methods and the process of learning. The aim of this paper is to present how to use the Internet and its resources in the learning process in a senior secondary school. I refer of my experience how supervisor in a teaching project in a technical institute in Italy (students aged 16-18).

Introduction

The computer technology has become a fundamental part of education across the curriculum and will likely be more so in the future. Instead of simply being a source of information, computers are becoming multimedia workstations for students. Innovative use of technology combines telecommunications (e-mail, online resources, Internet navigators), multimedia authoring (home page editors), user-friendly convenient applications software and are turns students into producers as well as consumers of content. The role of the classroom teacher is evolving from that of a giver of information to that of a facilitator of student learning. New technologies already exist to help teachers complete that evolution. The project "Surfing in the Web" is an example in this field. It has been divided in six stages: the knowledge of the Internet, the research in the Internet, the access to the FTP, the didactics with the Internet, the creation of Web pages, and the communication using the "Net".

The knowledge of the Internet

In the first stage the students, organised in eight groups each of two persons, have learnt the Internet directly in the Web using some special interactive lessons, developed by the Department of Science of Information at University of Milan. These lessons are available at the Internet address:
http: // twilight.dsi. unimi.it/ Users/sdi/barbacovi/prog1/Lezione/indice.html.
This hypertext has been developed for the course of Science of Education and it is a good example of educational hypertext. Using these interactive lessons the students have learnt: the correct navigation in the Internet, the recognition of the different types of hyperlinks (e.g. hot words, icons, buttons, and images), and the netiquette.

The research in the Internet

The search of information in the Internet still constitutes a bottleneck for the "net". For this reason, in the second stage, the students have learnt to use the search engines (e.g. Altavista, Yahoo, Virgilio), comparing their performances using the same keywords. They have also discussed these results.

The access to the FTP

The Internet is a big archive of information. In the third stage the students have analysed the capability to download, to install and to use some shareware and freeware software (on mathematics, geometry, Italian literature, and information technology) in their educational process.

The didactics with the Internet

The Web is argued to be the next technological tool to be used in the delivery of educational material. In this stage the students have used some educational Internet sites dedicated to the Italian literature, to the mathematics, and to the geometry. To study Italian literature I have proposed three interesting Internet sites:

- http:// tutti-c611.uibk.ac.at/nanda / Manuzio/000ind.htm (it contains texts of Italian literature);
- http: // www. ecs.net/scrivere/DANTE/GUIDA.HTM (to study Dante Alighieri's literary works);
- http:// www. augustea.it/~banfi/INFO/TG2/CARTELLI/LAVORI.HTM (dedicated to the Italian poems).

After the exercises proposed on these Internet sites the students have improved their composition technique.

To analyse the patterns and the groups of symmetry they have visited the Internet site:

http: // www.geom.umn.edu/apps/kali/about.html.

It contains the following applications: **Kali** (is an interactive editor for symmetric patterns of the plane, as seen in some of the woodcuts of M.C. Escher); **QuasiTiler** (that generates the famous Penrose tilings, or design nonperiodic tilings of the plane; in the process, we can select and visualise plane cross-sections of a lattice in anywhere from 3 up to 13 dimensions); **Unifweb** (that visualise families of Riemann surfaces with a specified group of symmetries.); **Lafite** (that works with any discrete symmetry group of the hyperbolic plane).

The creation of Web pages

In the fifth stage the students have created a collaborative hypertext (using HTML) dedicated to Bonaventura Cavalieri (1598 - 1647) (an Italian mathematician) for an International Conference of Mathematics. In course of execution the phases have been: the bibliographical research of information (using some traditional textbooks or the Internet); the choice of information to put in the hypertext; the hypertext's story board; the realisation of the user Interface; the encoding of information in hypertextual form; the control of hypertext (links, hot words, and so forth). Fifteen students, organised in seven work groups, have developed: "Cavalieri's biography"; "Cavalieri: the religious figure", "Cavalieri's scientific production", "Cavalieri and the town of Verbania", "Bibliography", and "Other sites on Cavalieri" (with some links to other Internet sites). During this hypertext development, the students put a particular care to make "friendly" the user interface for easy navigation [Sala, 1999]. This hypertext is written in two languages: Italian and English, and it is at the Internet address: http: // www. verbania.alpcom.it/scuole/cavalieri/cav0e.htm.

This stage is an example of "learning by doing" environment because the students have also learnt the history of mathematics during the hypertext development.

The communication using the "Net"

The sixth stage has been dedicated to the communication with other European schools using the e-mail. In a particular case a disabled student of my classroom has researched (and found) some Italian and Swiss "cyber-friends". Internet became for him a new way to socialize (going out from the isolation of his classroom) and to overcome his handicap.

Conclusion

This project demonstrates that the Internet offers significant benefits in educational process, and it shows that there are clear educational advantages to be derived from collaborative student activities. When students work in groups and small teams, the interactions and activities frequently involve higher order and reflective thinking. Collaboration helps individuals to progress through their zone of proximal development through the communication and the joint activity in which they are engaged [Oliver, Omari & Herrigton, 1998].

References

Sala, N., (1999) . How to Use Some Multimedia Technologies in a New Course of Mathematics: the Case of Architecture of the Academy of Architecture of Mendrisio, In *Proceedings Book MSET '99*, Editor David A. Thomas, 310 - 315.

Oliver, R., Omari, A., & Herrigton, J., (1998). Exploring Students Interactions in Collaborative World Wide Web Computer- Based Learning Environments. In *Jl. Of educational Multimedia and Hypermedia* , 7(2/3), 263 - 287.

Teacher Development, Educational Reform and The Web

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Abstract: In many countries public school education is currently under severe pressure to change methods, content and mission. Many of us are struggling with ways to utilize technology, especially the WWW, to improve educational opportunities for all students and to assist teachers in developing the skills they need to support educational change. This paper will report on a variety of action-research projects conducted by our International Center for Education and Technology, both locally and internationally, in which teachers and teacher educators, including college and university faculty, are assisted to develop new skills and strategies in using technology to improve students' skills and concepts and to help prepare them for a productive and rewarding future.

Educational Reform and the Role of Technology

Many teachers are eager to make significant change in their classrooms but they lack needed skills in the use of technology to enhance and support new learning paradigms. They want do a competent job, but feel overburdened and isolated as they attempt the task of revamping curricula. Teachers, for the most part, are well aware that they must use the internet and especially, the WWW, to find information to help themselves and their students to broaden their subject knowledge with current, as-it-is happening news and information, deepen their conceptual understandings of curricular areas, get a broader view of issues by discussing, and getting feedback from peers and specialists with whom they can interact.

Our Approach

In each of the following sections, an aspect of our approach to teacher development and support will be briefly discussed, followed, by way of illustration, with description of a particular project.

The Teacher as Innovator

Instead of being the passive transmitter of canned curriculum, the teacher in our model creates a learning environment which takes account of students, their interests, needs, and strengths, and that focuses on the development of problem solving, creative thinking, and communication skills that will be needed by future citizens of the world. By example, the teacher demonstrates the value of using new technologies as she/he guides students to define and explore problems and issues that affect our planet, working cooperatively to find solutions that are acceptable to our larger communities.

Sample Project: Fabulous Frogs

In this project a teacher and her class of primary students gather information about frogs and, as they learn more, add their findings to a HyperStudio stack that the teacher has created to support the investigations of her students. The program consists of various options for students to explore what the group has already found and/or created. Possibilities include: an animation of the life cycle of a frog; a collection of facts about frogs from around the world; a section entitled Frogs in the News, which highlights scientists' concerns over diminishing populations of frogs as well as discoveries of many mutations in recent years; poetry, songs and stories about frogs; and web sites that concerns issues relating to frogs and other amphibians. After reviewing these options, students choose to work in one of the areas with the goal of adding new material to the program. This stack is posted on the Web and other classes of students are invited to interact and contribute.

The Learner as Thinker:

Our view stresses the active exploration and manipulation by students of both concrete and abstract objects, and places a high value on the need for interpersonal communication, cooperative planning and problem solving. It values the construction of new insights and ways of thinking, and joint problem solving by students and teachers alike, by means of project-based sequences of activities that formulate an integrated approach to learning.

Sample Project: Learn About Dinosaurs

In this project, the teacher and her students together gathered information about dinosaurs, visited local sites which house evidence of dinosaur life, interviewed several dinosaur experts and then created a multimedia CD of their learning, which includes: a timeline delineating the periods in which dinosaurs lived on Earth; discussion of the theories on the topic of why and how dinosaurs became extinct; evidence of dinosaurs in our local area; links to web sites with information related to a range of topics involving dinosaurs; a gallery of dinosaur drawings by students; and a quiz of dinosaur facts. The teacher and students had to learn HyperStudio, web browsing, html, sound editing and animation in order to share their learning with others.

Learning as a Collaborative Activity

One of our aims is to encourage teachers to develop support systems, within their own schools, with peers in other locales and with the scientific community. Teachers have told us that our projects have allowed them to step outside of their own classrooms to interact with other adults via the internet. They have been reflecting on their growing desire for collaboration and are realizing what a lonely profession teaching sometimes can be. Teachers are also helped to carry the concept of collaborative work to their students and their parents.

Sample Project: Save the Beaches

[illegible] this project, via a web site, a teacher has created an international community of students and teachers who visit beaches in their local regions, observe and collect data on the number and types of debris found there, and then analyze and report their data to the larger group. In this way, students are actively involved in the collection of information that contributes to producing a larger pattern of data than they could gather on their own. Teachers, alike, are collaborating with their peers in other regions and countries.

Sample Project: Raining Books: a Guide for Parents

In this project a teacher who desired to reach out to parents, learned how to use multimedia and the WWW to prepare a guide which parents could access via a web site. In the guide are: an overview of the reading program in the teacher's school; a wide range of ideas to help parents to stimulate their children's reading at home, while shopping, etc.; web links to sites on children's books; and an email connection for parents to directly communicate with the teacher.

Summary

Telecommunications and multimedia, including CD-ROM technology and the WWW, have the capacity to transform classroom learning from a closed didactic system to a open, exploratory and collaborative experience. We view the technology that we use, such as telecommunications and multimedia as providing opportunities to authentically accomplish the hands-on, inquiry-based learning that are essential to systemic reform in education. With these tools teachers can assist students to communicate ideas to peers, and to the larger community, rather than produce work for the eyes of their teachers only.

Moderating the Future: The new Challenge for Educators

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1. On-line seminars

Distance learning via the WWW is a new field for higher education. In times of financial restrictions, the demand for more efficiency and effectiveness is often connected to the potential of tele-supported university teaching. New media require different styles of conveying knowledge and it raises questions about which didactic methods are applicable to Web-based teaching. New methods also demand intensified preparation. Whereas it is becoming more popular to use the Internet as the technical platform for the distribution of on-line study, many descriptions, and reports, promote the thesis that almost unlimited possibilities exist in education that just have to be implemented. Frequently, a positivistic view is held which pushes the discussion of problematic areas such as interactivity, appropriateness of web delivery, and learner control that on-line learning offers into the background. The educational gain in relation to the effort for development and realisation of effective instruction is seldom mentioned.

The on-line seminars (*http://seminar.jura.uni-sb.de*) of the Institute for Law and Computer Sciences (*ILCS*) at the Saarland University have proven to be far more time and personnel intensive than regular courses, but they open up new possibilities for students and teachers, and afford interdisciplinary and international collaboration. One advantage of on-line courses is the potential for communication, collaboration, and the exchange of knowledge between students and educators which can be made available that can bring them closer to (and perhaps supersede) "real life" teaching. Computer-mediated communication (*CMC*) therefore becomes an important research area for education.

2. Design and development

Designing and developing effective on-line courses requires attention to technical execution, adaptation of content and course concepts, attention to motivation, and must afford interactivity. On-line support during the on-line seminars consist of technical work as well as on-line mentoring support. We have found that communication between participants need to be regular and that these communication processes need to be checked continually (several times daily) to detect potential problems and initiate immediate intervention to avoid negative outcomes. During the 1998 seminar an average of 87 messages a day was written. The majority of these communiqués (38) were between participants, additionally there was an average of 8 messages to the team that required immediate response. Given these facts, participant interaction and their mails have to be monitored constantly - even on weekends.

2.1. Mentoring the Process

Mentoring takes on a new dimension in an on-line environment. We are challenged to "mediate" in ways that Reuven Feuerstein, Lev Vygotsky [Feurstein et al 1980, Vygotsky 1986, 1987] and others define as mediation. By facilitating, modeling, and coaching we begin to have new insights into mediation, instructional

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strategies, response to learner queries, and facilitating online discussion and fostering critical thinking. We anticipate, through an analysis of the discussion threads and collaboration threads, that we will be able to identify types of dialogue as well as a framework for guidance to support and facilitate a collaborative on line environment.

Our goals as moderators and discussion facilitators is to keep the "conversation" flowing, focus and refine ideas, challenge/ask learners to explore deeper into critical issues, and support and scaffold an on-line community. Marrying strategies related to electronic communication and critical thinking, will help foster a community of learning in a virtual environment. On line collaboration as well as effective moderating *must* be designed if it is to have comparable impact to face to face instruction. Through conscious effort and application we can bring voice and tone to bear in an otherwise sterile and distant environment. We can become reflective guides, or a personal muse to a learner. We are mediators and facilitators; generative guides and conceptual facilitators. The same environment issues that can be weaknesses in a learning environment can be exploited creatively to make learning come alive.

2.2. Design More than a Technical Matter

Apart from technical aspects, designing the virtual learning and work environment for students requires an interdisciplinary approach which incorporates research from various disciplines including: sociology, educational psychology, systems theory, communications theory, instructional design, diffusion of innovation, and visual perception/literacy.

In the field of sociology, recent attention has focused on creating successful group environments as well as dynamic group interactions. To inspire co-operation, crucial elements are arranged so that individuals will be able to meet each other again, and in doing so they must be able to recognise each other and last but not least they must have information about how the other has behaved until now [Axelrod 1984. The system should also support some form of history of who has done what, this is echoed in the research of Mike Godwin in his *Nine Principles for Making Virtual Communities Work* where he points out that the system must provide institutional memory [Godwin 1994].

As we move toward a global community, this course demonstrates that the presence of the Internet paves the way to unlimited inter-cultural collaboration. This is true for learners as well as for educators who can now offer joined courses regardless of large geographical distances. The development of on-line courses presents a variety of new challenges. In today's world, an international orientation is welcome and necessary - not only for students as the evaluation of the courses shows - but the evaluation also suggests that students really value on-line learning which allows them to study independently of a specific time or place.

On the other hand, the development of on-line courses presents many new challenges for teachers. One of the challenges of on-line courses is their design, diffusion, and integration into daily university life within feasible economic constraints. To develop an approach that is both efficient and effective, special attention has to be given to the user utilising instructional design principles that consider learner needs, existing skills, learning habits and work conditions.

3. References

[Axelrod 1984] Axelrod (1984), *The Evolution of Cooperation*. New York: Basic Books

[Feyrstein et al 1980] Feuerstein, R., & Jensen, M.R. (1980). Instrumental enrichment: Theoretical basis, goals, and instruments. *The Educational Forum*, 46, 401-423.

[Godwin 1994] Godwin, M (1994), *Nine Principles for Making Virtual Communities Work*. Wired 2.06 (http://www.wired.com/wired/archive/2.06/vc.principles_pr.html)

[Vygotsky 1987] Vygotsky, L.S. (1978). *Mind in society*. M.Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds). Cambridge, MA: Harvard University Press.

[Vygorsky 1986] Vygotsky, L.S. (1986). *Thought and language* (rev. ed.). A Kozulin (Ed.). Cambridge, MA: The MIT Press.

Are we Creating New Teaching Environments with Web Courseware Tools?

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Abstract: During the fall of 1998, the University of Texas at Austin adopted WebCT as a courseware tool for faculty who opted to enhance instruction. This poster session will present an overview of some of the online pedagogical issues and assumptions that must be addressed as faculty use this new learning environment. Most of UT's faculty training has concentrated on the mechanics of the software, since there tends to be a resistance to theoretical discussions. However, there is valid concern that technological convenience can take precedence over instructional practice. We are finding that faculty can create a course with WebCT, but need assistance finding ways to provide students with adequate information delivery, analysis, and in application opportunities. With online environments, learners can be more in control of learning, but they need guidance in order to activate appropriate learning strategies. Lessons learned and ways to address improving courseware instruction will be discussed.

Online Robotics Education at NASA.GOV

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Abstract: Robots were once the stuff of science fiction and the future. Now they are everyday real science and yet still, endlessly fascinating. This fascination coupled with a curiosity of how and why robots work is a learning opportunity that can be explored across many disciplines. To tap this educational potential and share the large body of work the agency performs in robotic technology, NASA makes current events, research results, and educational activities available to the public via the Internet and Web technologies. This paper identifies some of those educational sites associated with NASA robotic development and space exploration.

NASA studies our universe by sending science instruments into interstellar space, creating a virtual presence among the stars. Robotic probes and Remote Operating Vehicles (ROV's) help develop the scientific knowledge future human exploration missions will need to be successful. The robots gather information about remote destinations and promote flight readiness with their new technologies such as advanced miniaturization, intelligent systems, autonomous operations and simulation-based designs. The knowledge generated by the space science community in these projects is disseminated to the education community at large to communicate research results, share the excitement of space exploration and promote educational improvement. Information about NASA's robotic development, exploration and technology can be found at many Web sites and appears to fall into several categories; traditional course materials using the Web as a distribution mechanism, physical robot hardware with an online interface, interactive projects, and simulation-based robotic activities. This short paper identifies online NASA robotic resources as applied to math and science education.

NASA's increased focus on robotic missions is well represented by traditional types of course materials published on the Web. For example, the Mars Pathfinder and Sojourner ROV landed on Mars July 4, 1997 and sent collected data to Earth about the environment and composition of Mars for about 3 months. Right now there are 3 more ROV's orbiting or in flight to Mars within the Mars Exploration Program; the Mars Global Surveyor, the Mars Climate Orbiter and the Mars Polar Lander. Lessons and info about these robotic technologies, instruments, and experiments are available online to educators at a variety of locations. The Mars Exploration Education Program provides curriculum guides, fact sheets, slides, and images in an online environment and the Planetary Data Systems has an in-depth profile of the red planet. Information and activities about Mars and other innovative programs can also be found at the Live from Earth and Mars site, Mars Quest and Spacelink. NASA is also currently studying Jupiter's atmosphere, structure, and composition with the Galileo spacecraft and recently launched the Stardust mission to return captured comet particles to Earth for study by the scientific community. These are a small sample of the online curriculum materials available in the area of robotics. For other resources, in the nasa.gov domain, activate the search function from the NASA homepage or visit the NASA Space Telerobotics Page.

There are several NASA supported school programs in which students have an opportunity to build a physical robot to accomplish a given mission. These projects require students to perform practical tasks in the areas of mechanical engineering and computer programming while being mentored by engineers. The robot hardware is typically underwritten through grants and corporate sponsorship and information is accessible on the Web. Botball is a high school based program set up to interest students in science and engineering. Teams of students and engineers design and program a small mobile robot to compete in a regional tournament. The project includes Internet research on robotic topics and a robotic design contest. A larger scale robotics competition is known as the FIRST Robotics Competition. FIRST is an acronym which stands for "For Inspiration and Recognition of Science and Technology" and is a non- profit organization that seeks to generate scholastic interest in science and engineering. Students team up with NASA, university and industry engineers during a six week period to design, construct, and test their robots. The teams then compete in regional tournaments and a national tournament at the Epcot Center in Florida. individual teams web pages report the progress and status of robots under construction.

An example of an interactive, robotic Web activity educators can access is available at the Learning Technologies Channel. The LTC recently presented a series of Internet broadcasts on NASA's Marsokhod Rover testing from the California desert. The Real Media audio and video streams were broadcast live and are now available in the LTC archive. During the live LTC media broadcast, students asked NASA experts questions in a moderated chat room. The Marsokhod broadcasts covered topics such as the onboard science instruments, navigation, traversal, task performance, environmental analysis and sample retrieval. The LTC also broadcasts university courses in robotics as part of NASA's partnership with the University of North Dakota and Western Governor's University. The Telescopes in Education program allows students to operate a remotely controlled telescope and charge-coupled device (CCD) camera in a real-time, hands-on environment. The TIE program utilizes a science-grade, 24-inch, reflecting telescope at the Mount Wilson observatory which is used by students around the world to observe many different types of astronomical phenomena. Students increase their knowledge of astronomy, astrophysics and mathematics while remotely operating the telescope.

Simulation-based software called the Web Interface for Telescience or WITS was developed at JPL to allow scientists to participate in real planetary rover missions from any location. The public version of WITS allows the user to view and download science data and interact as a mission scientist with a simulated rover. The user plans and executes a rover science mission within a panoramic view of the extraterrestrial environment. WITS is an adaptation of a sophisticated tool and is most appropriate for high school and college audiences. Currently under assessment for educational use is the development of an Internet-based haptic interface. The haptic interface will give users a sense of touch in their online environment as they explore elements of robotics. A robotic simulation developed for students to build, train and run an online robot is called the ROVer Ranch. Remote operating vehicles are created and trained to perform missions in physically remote environments. Students create their vehicle at a workbench consisting of idealized body parts like thrusters, roller wheels, propellers or independent legs as locomotors; solar panels, generators, batteries as energy sources; and light, heat, chemical or tactile units as sensors. Students train the ROVer in basic movement techniques and required conditions for decision-making. Appropriate and optimal combinations of ROVer parts and training are directly correlated to task success. The completed ROV then runs in a simulated environment performing tasks such as mining, exploration and object location/retrieval.

While the robotic information NASA publishes is a rich body of work for educators to use when teaching math and science, it is important for educators to identify the sites that fit their teaching styles and needs. The sites mentioned encompass concepts and problems associated with engineering a viable robot or remote operating vehicle. Some sites are geared towards gears literally, while others are an abstraction of the concepts of robotic technology. Project oriented and/or student-centered learning environments can use many of NASA projects as an entire module. Other teachers may find that pieces of a project or projects fit best within their teaching curriculum and time constraints. There is enough variety and depth of information to convey basic robotic information to different age levels and learning styles. It should be noted that projects which involve building actual hardware robots may require corporate underwriting or financial grants from organizations such as NASA. An annotated reference list can be found online at http://prime.jsc.nasa.gov/references.html which lists traditional curriculum Web sites, projects with physical robots, interactive projects, and simulation-based software.

Developing Interactive Lecture Notes

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Abstract: With the appropriate use and organization of Internet based technologies, interactive lecture notes can be developed which not only help to stimulate a student's learning experience, but more importantly, attempt to truly educate as oppose to merely providing information to a student. By identifying the key features of the complex human learning process, a practical approach towards the goal of creating a truly self-instructional web-based lecture course is presented.

1. Introduction

Lecture notes that merely present web-based textual information with static diagrams only scratch the surface of the educational process. This is because of the complex human learning process, which essentially consists of utilizing any prior knowledge and experience to comprehend new concepts, and to subsequently strengthen ones understanding by working through examples. Throughout this process, several discussions may be necessary between a student and the lecturer, in an attempt to identify the root of any difficulty. The nature of these discussions will depend on the feedback provided by the student, and the lecturer's ability to make an educated response, targeted at the skill and ability level of the student. The subject of this paper is to address these issues by presenting some interactive web-based techniques, together with an effective interactive methodology. The interactive process may be separated into the following two modes. The first mode is the interaction between a student and the lecture material via a web browser. This form of interaction is based on the clever use of existing Internet technologies, including the facility for communication between students and the lecturer via email, message boards, or a chat forum. The second mode is the traditional face-to-face interaction between the students and the lecturer. The subject of this paper deals mainly with the first mode of interaction, with the underlining assumption that the second mode of interaction is available. Indeed, it will become evident in the sections to follow that the second mode of interaction is essential to complete the educational process.

2. Feedback and its incorporation

The most important aspect of developing interactive lecture notes is to create a feedback mechanism. For example, a JavaScript feedback form may be submitted by a student to the lecturer via email, which allows the student to specify via a drop down menu, whether the nature of the feedback is a comment, suggestion or a question [1]. As a consequence of the feedback, the lecture material need not be cluttered with further details. An elegant solution is to insert a tip or a hover [2] window at the appropriate place using JavaScript, in which respectively, the user either clicks or hovers the mouse over an image or an underlined text to launch a small additional browser window within which further clarifications are provided. Alternatively, with a little imagination, one can embed within the lecture notes, video clips or simple cartoon animations [3] saved in the standard AVI format to help clarify complex diagrams, and illustrate concepts. Sound clips may also be used to provide additional information. Unfortunately, a soundcard and speakers are not a common feature on most computers.

3. Interactive Internet technologies

Any form of interactivity will capture the interest of the student, and more importantly, help the student to gain a better understanding of the material presented. Typically, Java Applets provide a wonderful opportunity to embed interactive examples within a given lecture. For example, a student may interact with a graph plotting Java applet which re-plots the curve depending on the parameters set by the user [4]. A nice alternative is to use a general purpose graph plotting function [5] scripting applet, which is controlled by JavaScript. The added advantage of using such a scripting applet is that the student may specify the function to be plotted. Multiple choice questions are inherently interactive. Using JavaScript, one can also provide the option of checking any given answer, thereby allowing the user to learn from incorrect answers [6]. Solving tutorial questions is an essential part of the learning process. To encourage and help students attempt tutorial questions, an interactive tutor [7] based on JavaScript image roll-overs may be used as follows. For a given question, three images labeled "Hint 1", "Hint 2", and "Answer" are presented to the student. A hint or the answer is revealed by moving the mouse pointer over the corresponding image. To encourage a student to work out the full solution, the complete solution is not available, even with both hints revealed. An on-line *message board* [8], which is alternatively known as a discussion forum, provides an opportunity for the lecturer to answer common queries, and to enable discussions among the students. Microsoft FrontPage [9] provides a setup wizard to automatically create a message board. Finally, no matter which Internet technologies are utilized to create an interactive feature, it is extremely important the technologies are fully supported by a common web browser. Any interactive feature which requires the student to download and install a special plug-in software is unfortunately doomed to failure, no matter how effective the interactivity. This is because typically, students are unwilling to install additional software for a variety of reasons, which include the time required to download and install, and a lack of confidence to successfully install software.

4. Interactive Methodology

Interactive features of the type highlighted in sections 2 and 3 require an ability to exploit the available Internet technologies. This is a very important and often the most difficult aspect of developing interactive lecture notes. Furthermore, it very difficult to create an interactive medium which adapts itself to the skill and ability level of a student, and is able to respond with the appropriate material based on the nature of difficulty faced by the student. The only effective solution currently available is the traditional face-to-face mode of interaction, which enables a lecturer to quickly and effectively solve individual student difficulties. The added advantage is the inherent feedback which may be used to further improve the online lecture material, and its interactive features. A very effective technique is to copy the lecture notes from the web server onto a laptop computer, and use an LCD projector to enable the whole class to view the lecture material. By presenting the lectures in this manner, the lecture material will continually evolve towards a powerful self-instructional interactive lecture course.

5. References

[1] http://scitec.uwichill.edu.bb/cmp/online/P10D/feedback/feedcmp.htm
[2] http://www.builder.com/Programming/Scripter/?st.bl.pr..ss
[3] http://hotfiles.zdnet.com/cgi-bin/texis/swlib/hotfiles/info.html?fcode=0002U9&b=
[4] http://scitec.uwichill.edu.bb/cmp/online/P10D/lecture3/lect3.htm
[5] http://scitec.uwichill.edu.bb/cmp/online/P10D/Physlet/PlotFunction.htm
[6] http://scitec.uwichill.edu.bb/cmp/online/P10D/quiz/quiz.htm
[7] http://scitec.uwichill.edu.bb/cmp/online/P10D/tutorial/hint/p10dhints.htm
[8] http://scitec.uwichill.edu.bb/cmp/p10d_frm.htm
[9] http://www.microsoft.com/frontpage/

A Three-Dimension Structure to Learning Object Management

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1. Introduction

With the growing use of the Internet resources for purposes of teaching and learning, it becomes more and more important to develop a well-defined description for the management and distribution of learning information on the Internet both for the information suppliers and consumers [Song 1998a]. Many approaches to the management of learning resources in the Internet have been provided but with the aims to one particular aspect or another. Most of the research work on learning domain focuses on the description of learning content and pays little attention to the media maintaining the learning content. Even less effort is paid to the analysis of degree of ease-difficulty of learning objects. This factor is not only important but also a real demand from the end user.

In this paper we propose a managerial framework for learning object analysis, which is considered to be an overall view for descriptions of handling teaching and learning information, called learning objects. This framework contains descriptions (or attributes) of content, carrier, and knowledge intensity of learning objects. These three concepts are considered to be most important for management and analysis of learning domain.

The paper is organized as follows. In the next three sections we informally discuss three major aspects focused in the paper, i.e., learning domain, knowledge carrier, and learning intensity. In the section 5 we propose a formal definition of the three dimension structure for a learning object and point out how we will use the concept in applications in the following section. We conclude the paper in Section 7.

2. Learning Domain

A learning domain can be considered to be a collection of knowledge with specific characteristics for purposes of learning and education [Andersson 1999]. The collection of learning knowledge is organized based on semantic relations. Such semantic relations describe an intrinsic (collocation) structure of learning content. For instance, knowledge about computer programming is a basis and subsequence of knowledge about computer algorithm. The precedence of the knowledge about computer programming and algorithm depends on how we describe the two subjects, i.e., what attributes (or characteristics) we select for the subjects (or learning objects) and what values we assign to the attributes.

The extraction of attributes for a learning domain is critical for modeling the semantic relations. These attributes can be constructed from the characteristics of the collection of knowledge and their collocations. These attributes are used to associate a learning object to a set of values, which describe the learning object on one hand. On the other hand, the attributes are also used to create relationships between learning objects. The relationships relating an object with other objects form a **semantic** context for the learning object of interest [Song 1996]. Such cross references can capture an entire semantic picture of a learning domain.

3. Knowledge Carrier

Carrier is a medium that provides a display of knowledge content. A same content can be carried in different media. In a learning domain, the carriers maintaining learning knowledge play an extremely important role in providing versatile styles of learning and education information and therefore improving understandability and entertainment for the users. For example, two kinds of carriers for a conference proceedings can be a very thick book and a CD-ROM (the electronic proceedings). Obviously, people may prefer the CD-ROM to the proceedings book because the latter is difficult to carry whereas the former provides better search-ability for articles.

A carrier for a learning knowledge needs to be described in terms of a set of modeling attributes to distinguish it from other carriers.

4. Learning Intensity

Learning intensity indicates a spectrum of learning domain, where at one end the knowledge collection is common sense and on the other the knowledge collection from the experts. In other words, if we assume a scale to represent the learning intensity of how easy a course to be learned, we can say five degrees of very easy, easy, medium, difficult, and very difficult. For example, we may say the knowledge intensity increases in mathematics from primary school to high school. The importance of identifying the knowledge intensity (degree of ease-difficulty) for learning objects lies in the fact in which people need select learning objects according to their requirements, experiences and the already acquired knowledge.

The attributes used to describe the learning intensity can be included in those to describe a learning domain or a set of learning objects. However, these attributes are of special interest so that we need to consider them alone.

5. Three Dimension Structure

The above discussed aspects for learning objects can be grouped together to form a three dimension view or three dimension structure for describing learning objects. In other words, we intend to build up a metadata description framework (metadata model) for structuring learning resources. The metadata model will contain constructs based on the consideration of these three dimensions of learning objects.

We define that a learning object, denoted as lo, has three associated metadata, i.e., learning content (lc), knowledge carrier (kc), and degree of knowledge intensity (ki), i.e., a learning object is lo = (lc, kc, ki).

The three types of metadata components are three sets of attributes for a learning object, each having the form of <a1, a2, …, ai>. The attributes of learning content for a learning object, e.g., a book, include subject, keyword, etc. The attributes of knowledge carriers, e.g. video, include topic, size, playtime, etc. The attributes of knowledge intensity degree for, e.g. lesson, include level, target group characteristics, etc.

One major requirement on the metadata model is that the model should be in accordance with the RDF (Resource Description Framework) Model, recommended by the World Wide Web Consortium (W3C) as an international metadata standard. The foundation of the RDF Model is a model for representing named properties and property values, with a form of

<r, p, v>,

where r, p, and v stand for resource, property of the resource, and value of the property respectively. Using this RDF Model representation form, we can express a learning object as

<lo, lc, lc.attr_list>
<lo, kc, kc.attri_list>
<lo, ki, ki.attr_list>.

Here attr_list is a list of attributes and can be seen as a set of resources, which in turn have their own property and value. For example, <BOOK, lc, SUBJECT> and <SUBJECT, "is", "metadata"> represent a resource BOOK has as its learning content attribute SUBJECT with a value of "metadata".

6. The Use of Three Dimension Structure for Learning Objects

The diversity and massiveness of learning resources over the Internet brings the convenience for people to access to various types of learning knowledge but at the same time reveals the difficulty of quickly searching for exact learning information people require. A well-structured representation for these learning resources in a learning domain is indispensable [Song 1999b]. Our three dimension structure is proposed to meet this users' requirement. This description framework can be used as a metadata model or embedded in learning information systems as a basic structure for learning knowledge representation. Since the model distinguishes a learning object (resource) among its content, carrier, and degree of knowledge intensity, it greatly supports classification and management of learning domain. The application of the description framework can also be extended to other application areas, for example, digital document management and exchange [Ekengren 1999].

7. Conclusion

The three dimension structure for learning objects is developed at the SITI project LOUIS (Learning Objects for Usable Information Systems). Its advantages include helping people to consider a learning object along different lines of thought and to discover intrinsic structure of learning objects. As an example, it is suggested to include a fourth dimension to our description framework, i.e., process or versioning of learning objects.

An important phase closely related to learning objects is a so called "concept catalog", where a learning domain specific vocabulary is maintained. The concept catalog provides an interpretation of "words" (values to attributes) for different types of the attributes for learning objects. These words are used for identification of various attributes. In the next step of the LOUIS project we attempt to define such concept catalog.

References

[Song 1998] Song, William and Mats B. Andersson, (1998) An investigation of research on learning domain and related issues, Project Report, SITI Project LOUIS, Stockholm, Sweden.

[Andersson 1999] Mats B. Andersson, (1999) Learning Domain – Education on Demand (in Swedish), CID Report, Centrum för Användarorienterad IT Design, The Royal Institute of Technology in Sweden, Stockholm, Sweden.

[Song 1996] Song, W., Johannesson, P., Bubenko J. (1996) Semantic Similarity Relations and Computations in Schema Integration, 1, Journal of Data and Knowledge Engineering, Elsevier Science, The Netherlands.

[Song 1999] Song, William and Mats B. Andersson, (1999) A Component-based Framework for Description and Management of Learning Objects, WebNet'99, Hawaii, USA.

[Ekengren 1999] Ekengren, Dag, (1999) RDF for Multimedia Broker – Metadata on the Web, Master Thesis, The Royal Institute of Technology in Sweden, Stockholm, Sweden.

A Component-based Framework for Description and Management of Learning Objects

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1. Introduction

The growth of the Internet and the World Wide Web is transforming teaching and learning at all levels of education in the workplace and at home [IMS]. The information pieces or resources for purposes of learning and education construct a new type of web resources. This new kind of web resources with quite distinct features is evolving on the Internet, called Learning Domain. An important characteristic of these resources (asynchronous systems) is that it can be used as a teaching medium as well as a source of knowledge about a subject area [MBA1, MBA2].

Two major parts, closely related to a learning domain, are learning resource providers and consumers. The information providers supply learning resources and the information consumers use the learning resources. Usually, learning information, such as courses, is stored and managed in an information system or a local web site. The supplier may give a sort of description of the structure of the information. This description is termed as metadata. A means for the information suppliers to describe metadata is called metadata model.

From the point of view of the resource consumers, they expect to easily find the exact learning knowledge they need. The requirements and goals express what sort of learning materials they are seeking. The consumers may also provide their profiles as support. Indeed, profiles are sometime quite helpful. However, these requirements and goals can be vague, ambiguous, and even in conflicts. The profiles provided by the end users are very likely incomplete and bias-prone.

In the next section, we describe several concepts used in the paper. In section 3, we propose a metadata model for learning objects through defining possible components within a learning domain. Then in section 4, we discuss an implementation issue for learning system based on a metadata tool. In the final section we conclude the paper with some discussions of our future work.

2. Basic concepts

Granularity of learning objects define a relation between the degree of accessibility and what kind of information motivated to offer and how it should be structured. The granularity or refinement of learning objects in a learning system depends on the content and the carriers of the content. What **granularity** (i.e., how deep we shall decompose an object or a component) we should achieve relies on the users' requirements [WS2].

No matter how an education system will be used, it is necessary to handle the learning content in a modular form. Such module in a learning system is called learning object. **Metadata** and **metadata model** are used to support the organization and structuring of learning objects.

Therefore, metadata modeling and granularity should be taken into account for the management of learning objects, while the premise for granularity is the decomposability of learning objects [WS1]. We consider to break down a learning object into a number of sub-objects, called **components**.

3. A Metadata Model for Learning Objects

We propose a framework of metadata model, in which each component (node) in the metadata model consists of two major parts. One is the data description part and the other the operation description part. The data description part provides a set of building constructs for designing a metadata-modeling schema for a web document. The operation description part provides a set of operations that apply to the data of the components.

The framework consists of two models, a data model for data description and a component model for component and operation description. The data model contains three primitive constructs: objects, describing the concepts for e.g. documents, relationships, describing relations between objects, and attributes, describing object properties.

The component model describes different types of metadata, including e.g. carriers and operations. We consider that each piece of information has a sort of carrier. For example, a movie is a carrier of a story. The story can as well use another carrier, e.g. a textual document.

An object can be any component or unit in a learning domain. A learning domain is a collection of any educational, training materials (objects) or information. The learning domain also contains one or several description structures for the organization and use of the learning objects. Information providers are supplying learning objects for a learning domain along with some structures (metadata) for learning objects. Information consumers will obtain the learning objects, which may be reconstructed and integrated based on the consumers' requirements and needs.

An object is described by a set of attributes and relationships. The relationships in the set relate the object to other objects. A subset of the set of attributes and relationships may be able to uniquely identify the object, called identifier.

We also maintain two kinds of modeling structures in the metadata model. They are hierarchical structure and network structure. In the hierarchical structure of learning object components, we maintain three types of relationships: part-of, is-a, and sibling. These three types of relationships are used for defining basic decompositions of learning objects. The part-of relationship indicates the fact that an object is a part of another object. This relationship is also called whole-part relationship. This definition is very useful when we attempt to group a number of components from different learning objects to generate a new learning object. For instance, a table may consist of a flat and four legs.

In the network structure, learning objects are related to each other based on their natural relationships. For example, a course may be related to teachers, locations, payment methods, etc. That means, if we take the course, the teacher, the location, the payment method, as some nodes in the network structure, the relationships established between them will be given_by, located_at, paid_in, etc.

4. RdfClient: A prototype to represent Learning Objects

RdfClient is a tool for viewing an RDF (Resource Description Framework) schema or document [DK]. It is intended to support users to authorize a metadata modeling schema and document in terms of the RDF syntax and constructs. The RDF metadata framework is defined for the representation and communication of various information items from the Internet or Intranet. RdfClient can be considered among few tools for the metadata information description to support particularly a hierarchical structure for the description and management of digital documents.

Based on the metadata model discussed previously, we use RdfClient for illustration of the structure and the use of learning objects. We consider it very useful to include the operations such as decomposition and re-composition. In accordance with the learning object methods, we maintain a hierarchical structure for the learning objects. By using the tool, we maintain three main components, a hierarchical structure of metadata information for documents, a descriptive information of the metadata schema especially designed for the documents, and a group of binary elements of relationships (called property type in RDF) and values for the metadata information of the documents.

5. Conclusion

The report has described a particular metadata model for learning domain and an implementation for the model in a prototype. Our next step for the project, other than further development and refinement of the metadata model and prototype, we will tackle the following three problems.

1) Establishment of a network structure for representing learning objects, its coupling with the hierarchical structure, and mapping both structures to a repository. 2) Design of a graphical user interface for authoring learning objects and their relationships, as well as operations on the objects. 3) Design of a goal-matching mechanism. For example, if we see the users' requirements on a particular course, which need to be built out of the other course components, how to compose such course from a set of other existing course components can be considered to be a process of goal matching. This issue is extremely important when hundreds of courses are managed in the repository and about ten requirements proposed from a user for a particular course. The issue leads to what strategies can be adopted to match the user's goals and automatically or semi-automatically find the right course.

References

[Song 1998] Song, William and Mats B. Andersson, (1998) An investigation of research on learning domain and related issues, Project Report, SITI Project LOUIS, Stockholm, Sweden.

[Andersson 1999] Mats B. Andersson, (1999) Learning Domain – Education on Demand (in Swedish), CID Report, Centrum för Användarorienterad IT Design, The Royal Institute of Technology in Sweden, Stockholm, Sweden.

[Song 1996] Song, W., Johannesson, P., Bubenko J. (1996) Semantic Similarity Relations and Computations in Schema Integration, 1, Journal of Data and Knowledge Engineering, Elsevier Science, The Netherlands.

[Song 1999] Song, William and Mats B. Andersson, (1999) A Component-based Framework for Description and Management of Learning Objects, WebNet'99, Hawaii, USA.

[Ekengren 1999] Ekengren, Dag, (1999) RDF for Multimedia Broker – Metadata on the Web, Master Thesis, The Royal Institute of Technology in Sweden, Stockholm, Sweden.

The Geek Shall Inherit the Earth – Designing a University for the Next Millennium

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Abstract: This paper explores the social and cultural issues faced in creating a new technology-based university. Issues and decisions around policy, faculty, industry relationships, program definition, and the use of web-based technology are addressed in the context of creating the new Technical University of British Columbia.

There are very few new universities being created anywhere in the world. Imagine the opportunity to pioneer a new kind of university. A university with a high technology focus. A university committed to the use of educational technology for learning development and delivery. What cultural and social issues would you confront in creating this university? What form and function would this new university take in response to its mandate? As one of the few new universities in the world the Technical University of British Columbia (TechBC) is meeting the challenge of innovating a new university culture while moving from concept to reality quickly.

Canada's province of British Columbia passed a bill to create TechBC in December 1997. By law TechBC is to:

- contribute to the economic development of British Columbia
- offer undergraduate and graduate degree programs in technological fields
- be relevant, and at the forefront of, industrial and professional initiative
- create strong links with other post-secondary institutions, business, and labour
- conduct applied research and development in collaboration and cooperation with business and labour

Another part of the Act decreed the university to have a unicameral governance structure with no academic senate. Immediately upon its inception TechBC was faced with an international boycott by faculty associations. The boycott was triggered by concerns that this mandate and structure would result in a loss of academic freedom. In addition, while the act makes no mention of tenure, the minister responsible had publicly stated that TechBC would not have tenure. Even before the university had a program, or faculty, social issues had to be resolved.

In response to academic freedom concerns TechBC created a policy extending academic freedom to the whole university community, including students and staff. Within its governance structure an Academic Planning Board was created. The universities' Board of Governors can only make decisions on academic matters that have the concurrence of the Academic Planning Board. Based on these resolutions the boycott was lifted.

TechBC has taken advantage of being a clean slate startup by breaking free from the historical legacy and entrenched practise of tenure in traditional universities. Faculty are hired on renewable, term contracts and are expected to spend up to forty percent of their time doing applied research in partnership with industry. Term contracts and applied research enable TechBC to ensure programs and staff are plugged-in to industry needs and at the forefront of initiatives. TechBC has been attracting entrepreneurial faculty from around the world, who are keen to be part of a startup and contribute to the creation of a new university culture.

TechBC had the opportunity to devise new programs of study focused on technology. The resulting programs are one of its biggest social and cultural contributions. Initial program areas are Information Technology, Management and Technology, and Interactive Arts. To help define the content and scope Program Advisory Committees for each area were created with industry representation. Industry was asked:

- What kind of graduates do they get now?
- What kind of graduates would they like to get?
- What kind of program would need to be devised to give them the kind of graduates they want?

Information Technology integrates four areas of concentration into a single field; computer systems engineering, telecommunications engineering, software engineering and software systems. This integration breaks down departmentalized notions of computer science and electrical engineering found in traditional universities.

Management and Technology acknowledges the unique business practises of technology industries and the way technology is changing traditional ways of doing business in all sectors. Project management, e-commerce, and global business are integral parts of this new culture.

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Interactive Arts is a new innovative program linking design and art practise to emerging technologies. Interactive Arts defines a whole new field of practise as applied to the creation of local media, linear media, network media, performance media, and mechanical media.

One of the exciting themes to emerge is the way these three program areas inform and integrate with each other. This is exemplified in the first year of study, called TechOne. Comprised of course elements from all three program areas, along with process elements of Team Dynamics, Effective Communication, and Learning and Information, TechOne creates a shared culture and common frame of reference for all learners regardless of which program area they intend to specialize in. The culture of TechOne establishes a technology foundation, understanding of business fundamentals, and an appreciation for the socio-cultural aspects of human use of technology. Integration between the three program areas continues in subsequent years through cross program projects, team teaching, and electives.

To foster integration even more, faculty are hired in to the university as a whole. There are no departments. Even the seating arrangements of faculty have been structured to mix and integrate faculty from all three areas together. Every effort is being made to create a new culture, free of siloed departments. Interdisciplinary communication between programs is a key ingredient of this new culture.

Educational technology is also shaping TechBC's culture. TechBC has evolved a integrated learning approach. Integrated learning combines the best practises of face-to-face learning with emerging web based technologies. At TechBC a part of every course is on-line. Some courses are a hundred percent on-line others only twenty or fifty percent. Integrated learning creates a flexible learning culture for learners reducing required attendance on campus from five days a week to one or two.

TechBC recognizes that reduced on-campus attendance creates a social issue. For many learners university life is as much a social experience as a learning one. To address this issue TechBC has created a three dimensional VRML world that creates a virtual version of a physical campus for social interaction. To enter TechBC World students choose and customize an avatar identity for themselves through their web browser. Entering into the VRML world learners can walk or fly through the entry garden, central commons, and in and out of buildings. When other avatars are encountered, interaction can occur via chat, whiteboard, physical gesture, and voice. Private conversations between groups of three or four people can be held in specific areas of TechBC World by enclosing the group in a small dome. Extensions to this networked TechBC World will include links to a digital library, presentation theatres, and art exhibition spaces.

TechBC is committed to collaborative team based learning. Face-to-face learning sessions are structured to de-emphasize lecture and instead create small work groups where teams of learners engage in discussion, projects, and case studies. This culture carries over into the on-line environment through the use of synchronous and asynchronous discussion, lab simulations, and networked communities of learning.

A major social issue that emerged around this new form of learning was the need to educate faculty on how to change from being lecturers to facilitators and the need to evolve a new form of course production. To address these needs TechBC established a group called Educational Technology and Learning whose role is to:

- develop models of learning that map to course content
- test and select emerging web-based educational technologies
- develop technology templates for faculty to use for course content development
- provide faculty development workshops that provide guidance on the use of technology and their new face-to-face role
- devise and assist with assessment methodologies
- manage the production process and schedule of course and program development
- find existing learning resources and negotiate licensing and copyright
- provide a production facility to suport the creation of new media learning resources

The Educational Technology and Learning group has emerged as an important cultural element of TechBC.

One final aspect of TechBC's new university culture is Corporate Education and Training. The fastest growing sector of today's educational market is the working adult. In today's high tech world the need to learn continues throughout your entire professional career. In recognition of these social changes, TechBC is committing to provide learning for its students not just to completion of a degree but for their entire career. TechBC has broken every one of its three credit courses into one credit modules. This modular design allows for mix and match creation of custom, corporate learning solutions. Small chunks of continuous learning can be provided right to learner desktops in the workplace. TechBC is leveraging its investment in educational technology to support learning infrastructure needs of knowledge-based companies and the lifelong learning needs of workers.

The cultural and social issues TechBC has grappled with reflect the societal aspects of pioneering the creation of a new, technology-enabled university. In the process of questioning and resolving these issues TechBC is creating a new model for higher education. To further explore the evolving world of TechBC, refer to our web site at: http://www.techbc.ca.

Asynchronous Brainstorm: An Intranet Application for Creativity

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Abstract: Informed by field observations of how proposals are handled in an organisation and inspired by the theoretical framework of organisational learning, I argue in favour of, and present design implications for, a web-based tool that facilitates organisational creativity though asynchronicity, anonymity, and persistency. However, early user feedback indicates that reward mechanisms must be addressed alongside the introduction of such IT artefacts.

1. Introduction

Many organisations encourage their members to submit improvement proposals. Often, these proposals are submitted to local Proposal-Handling Committees (PHC) that review the ideas. Good suggestions are usually rewarded in some way, while not so good proposals are rejected. However, I have noticed a few serious shortcomings with this traditional way of handling suggestions. First, the suggestions are seldom communicated sufficiently within the organisation: good ideas may be implemented locally but never heard of in other parts of the organisation. Other ideas may be prematurely rejected due to the PHC's limited cognitive capacity, the proposer's poor communication skills, bad timing, or being proposed in the wrong context. These ideas, good and bad, could have started other creative ideas elsewhere in the organisation, had they only been made public.

Second, many ideas are never proposed at all. We may feel that our idea is not worthy of being submitted as an official proposal, or we may be reluctant to present "silly" ideas if we risk losing face in front of our colleagues. Instead, we keep our potentially revolutionary ideas to ourselves.

I seek to develop mechanisms that better support organisational creativity, and this paper describes ongoing work with a web application that addresses the above shortcomings by enabling asynchronous brainstorming.

2. Related Theory

[March 1999] observes that most new ideas are actually bad ideas. Thus, to generate something useful, many suggestions must be encouraged. Further, inspiration should be gathered from a variety of disciplines. [Kanter 1996] refers to such cross fertilisation as kaleidoscopic thinking. This is exactly what happens in a brainstorm session, where people from cross-disciplinary fields interact. Though each idea in itself may not be so bright, the associative process that each idea feeds generates many and often creative results. Another success factor for creativity is the absence of early critique. New ideas must be given sufficient time to mature and to be explored, says [March 1999], since good ideas look identical to bad ideas until they are tried. New ideas should therefore be shielded from criticism during their early stages, and given sufficient time to linger after the brainstorming has finished.

Anonymity needs also to be considered. An authority, e.g. a manager or an expert, can kill an idea simply by contributing to the debate, explaining "how things are". This, sometimes old, wisdom is then never challenged. However, if there is no telling whom the proposer is, the suggestions are judged from their content only, without unnecessary prejudice or bias, giving new ideas a better chance of surviving. [Poole *et al.* 1988] have shown that anonymity also leads to better results since social barriers to contributing are lowered.

It seems to have been established that generating many ideas and letting these be visible, possibly inspiring further thoughts, has a positive influence on the generating of good ideas. Further, all these ideas should be allowed to mature and to be explored without initial criticism. They should be both submitted and approached with an open and unbiased mind, which can be achieved through anonymous submitting. Informed by these theories I worked out some design principles from which I implemented a prototype.

3. Design Principles

Brainstorm is a prototype system that mimics the creative atmosphere often found in brainstorm sessions, where no suggestions are turned down but used to spawn new and possibly even better ideas. Unlike ordinary, real life brainstorm meetings, the prototype supports asynchronous, networked "brainstorming", eliminating the time and space restrictions that otherwise exist. Ideas are, often only very briefly, sketched in an email and submitted to a SMTP mailbox, from which *Brainstorm* adds them to a web page. The web was chosen for several reasons: a) it is accessible from all platforms; b) there are many tools available to help users find information, e.g. search engines and agent-based applications; c) asynchronicity is added to the sharing process, i.e. users do not have to be active simultaneously which removes the temporal restriction present in e.g. chat forums; d) the persistent nature of the web page allows the idea to linger long enough for it to be found by many different people in different locations and contexts.

Brainstorm lacks the possibilities to add comments directly to the proposal, as is otherwise the case in Usenet Newsgroups. This helps shielding the idea from public negative critique. While *Brainstorm* allows for anonymity by withholding the return address of the proposer and not showing it on the web page, it is possible to contact the proposer either to ask for or to provide information. This is achieved by clicking a hypertext link next to the proposal and typing in a message. A CGI-script will forward the comment to the original proposer, who remains unknown. Though such comments may contain criticism, the original idea remains publicly available and can serve as a seed for others, while the critique is not displayed.

4. A Discussion Regarding Future Work

I have tested an early beta version of *Brainstorm* in a large organisation, and discussed the problems with proposal handling, and the suggested design of *Brainstorm*, with PHCs and individual members. One question raised was what will happen if an initial idea, proposed by A, inspires B to generate a better idea, which then is modified by C to the great IDEA that receives acknowledgement by the PHC and renders a gratification? Should not A and B have some credit? If not, they are instead encouraged to keep their ideas to themselves to try to develop them into what C managed to come up with. Such a behaviour would be very unfortunate, since chances are that neither A, B, nor C would managed to create the IDEA on their own. The IDEA was probably the result of the interaction of A, B, and C - a social knowledge creation process that required the input from all three parties. The question is thus legitimate because without proper incentive, technology, if ever so user-friendly, will not be used. The problem is how to create the incentive system because as [March 1999] points out, we do not want to reward mistakes but we should encourage the creativity that sometimes leads to them.

In the future, I intend to study conventional brainstorm sessions in more depth, and I further plan to implement a full version of *Brainstorm* to answer the above and other questions. Brainstorming is normally only one aspect of group creativity, and for the whole process to work, other factors such as shared knowledge, commitment to common goals, and mutual trust must also be established [Bennet & Karat 1994]. It can be argued that this cannot be accomplished in an anonymous environment. However, *Brainstorm* is intended for an intra-organisational web where a minimum level of common objectives may be assumed to be in place. Further, the objective of *Brainstorm* is not to deliver a full environment for collaboration and co-operation, but to serve as a catalyst for creativity. The purpose is only to get ideas out in the open for the community to share and move forward with whatever seems useful.

5. References

Bennet, J. L. & Karat, J. (1994). Facilitating effective HCI design meetings, Proceedings of CHI '94, New York: ACM press, pp. 198-204,

Kanter, R. M. (1996). When a Thousand Flowers Bloom: Structural, Collective, and Social Conditions for Innovation in Organizations, In Mayers, P. (Ed.) Knowledge Management and Organizational Design, Boston, MA: Butterworth-Heinemann, pp 93-131.

March, J. G. (1999). Wild ideas: The Catechism of Heresy, In March, J. (Ed.) The Pursuit of Organizational Intelligence, Malden, MA and Oxford, UK: Blackwell, pp 225-228.

Poole, Homes, & DeSanctis (1988). Conflict Management and Group Decision Support System, In Proceedings of CSCW'88, Portland, OR: ACM press, pp 227-241.

Architectural Detailing at Random: An Interactive Artist-Made Book On-Line

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Abstract: *Architectural Detailing at Random* is an interactive artist-made book that was first considered in 1986 after shooting Polaroids of "details" encountered doing renovations in a small Wisconsin town, Random Lake. Because local people talk about what goes on in this village as being "at Random," I imagined a book focused on architectural details of a house renovated "at Random." I loved moving the Polaroids into different visual combinations and wanted to design a book that invited viewers to devise their own variations. This sense of a book without finite limits is another play on the title "at Random."

It wasn't until I started working with web page design in 1995, however, that I found a form that would allow for the interactivity I imagined. It had taken nearly a decade for the Internet to develop to a place where I could realize my earlier concept in physical media.

In 1986 while working on my M.F.A., I renovated a house in Random Lake, a small town 45 miles north of Milwaukee, Wisconsin. During the renovation, I shot 26 Polaroid images which I intended to use in an artist-made book I planned to title "Architectural Detailing at Random." Local people living in Random Lake talked about what went on in this small village as being "at Random," and I used that idea in my titled; I imagined a book that focused on small, everyday architectural details of a house renovated "at Random."

I also loved moving these Polaroids around in different visual combinations and wanted to design a book that invited the viewers to devise their own variations. This sense of a book without finite limits was another play on the title concept of being "at Random." Because Polaroids are a one-of-a-kind medium, however, the design implications for creating such a book were formidable. I abandoned this book, despite the strong images and the playful combinations I repeatedly discovered, because in 1986, I could not design or imagine a form that would allow for interactivity with the viewer.

I first considered the possibilities of hypertext in a very general sort of way in 1991 when I attended a conference sponsored by Apple. Over time, it dawned on me that a hypertext environment is an ideal one for looking at images in a variety of combinations and for inviting viewers to participate in creating other variations, "at random" or deliberately. I imagined a "book" in which the on-line viewer could see my favorite combinations of image and then choose their own combinations. I also imagined the site growing over time as image sequences from people around the globe were included.

Once I was able to imagine an on-line form for the book, my creative process became one of primarily solving technological problems. First were the issues anyone new to designing web pages faces--how to control image quality in a format that is readable for a variety of monitor resolutions. The web is not yet an ideal place for an artist or designer to control color and image integrity. It wasn't until I was nearly finished with the project that I realized there are also issues related to crossing platforms to consider. Although I am moderately satisfied with this site viewing it in a Windows format, I am much more pleased with the result in a Macintosh environment.

Next were issues of site structure. How would the viewer navigate through the site and how could I control the rhythm of that movement without inhibiting the viewer from engaging in the interactive aspects of the work? Surfing the net introduced me to the ways in which others were presenting "gallery" images, usually with pages of thumbnail images that could be seen in a larger format if the surfer had the patience to wait. This however, did not serve to focus the viewer on a sequence of images, which was central to my design concept. Instead, I used an actually gallery wall as a metaphor and presented screens one after the other as one might walk through a gallery.

Finally, there was the issue of interactivity. How was I to create a "studio" space in which viewers could move the Polaroids around, see them next to each other, and decide on their own combinations? For this work, I turned to a college senior with some experience with Java. We collaborated over the course of a semester, discussing possibilities that he would then translate into code. When the day finally came that six page files were added to the site to give it interactivity, I was struck the ways in which that moment of realization brought our generational differences into focus. In 1986 when I first conceived of pages that any viewer could arrange and rearrange, the young man who wrote the code for me was in fourth grade learning his multiplication tables. It took nearly a decade for his math skills and the Internet to develop to a place where I could realize my earlier concept in physical media. What he takes for granted as a young person entering his 20's, I couldn't even imagine as a graduate student a decade ago in my 30's.

But what does it matter if one artist moves from using the computer and traditional media to produce illuminated texts in a book format to creating books designed to be read on the web? On one hand, this work is merely one example of a natural progression that is taking place in the culture at large--the move from print to digital culture. On the other hand, this work insists on its existence despite formidable resistance from those cultural norms that measure and put value on "art." Most cultural measures of "success" of either artist or artwork are related to exhibiting and selling a product. The more "important" the work, the more exclusive the venues for exhibition and the higher the price for the sale.

On the web, however, the venue for exhibiting work is democratic and, aside from the issue of computer access, for the viewer the work is free. To try and distribute this work in traditional fine art venues is extremely difficult. To begin with, the standard documentation for viewing artwork, whether gallery owner, curator, juror for an exhibition, or faculty search committee, is the 35mm slide. To strip a web site, no matter how traditional the site, down to a 35mm slide is to take away the very features that placed the art on the web in the first place. Secondly, should someone actually decide from a slide to delve deeper and go to the site, even if the work is accepted for exhibition, the issue of equipment in the gallery becomes another formidable hurdle--one not experienced by the painter or printmaker. Lastly, should the work, by some miracle, actually be shown in the gallery, there is no product to be purchased by the art patron, collector, or museum curator, and in the case of interactive works no one artist who can make claim to the work produced on the site. The work simply doesn't fit the profile.

Art has traditionally been a place where culture has pushed forward, where new ways of looking at the world and our experience in it have found form and expression. Artists have been our cultural prophets. But in this age, art as a discipline is uneasy and wary of the technology; college courses in computer fine art often focus on making two-dimensional images that fit comfortably in frames and document well in 35mm slide. And those most engaged by the technology, those who have been instrumental in moving the technology forward have often come out of math, science, engineering and industry and do not often have backgrounds in visual art. We must find ways to facilitate conversations and collaborations across these disciplines, and in doing so, create spaces for art on the web that don't just mirror "art-making" from a paint and canvas point of view. We have a stake in learning what artists might make in and of cyberspace, for what they make has the potential to change the space itself.

The Effect of Motive on Response Rates in Web-based Surveys: A Proposal based on the Heuristic-Systematic Processing Model

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Abstract

The process by which individuals perceive and make decisions about information on the World Wide Web (WWW) is an underexplored topic. This project seeks to gain an understanding of the motivational processes, which underlie decisions of individuals processing information from the WWW, particularly in a survey context. Understanding these processes may allow for the prediction and explanation of non-response, drop-out effects, and why some context effects occur in web-based survey data.

Background

The heuristic-systematic processing model (Chaiken 1980, 1987) suggests that there are two concurrent modes by which people process information and reach decisions: the heuristic mode and the systematic mode. Which mode predominates in a given situation depends on the individual's motivation and capacity to process detailed information. An individual who is unable (due to distractions) or unwilling (not motivated) to think carefully about information in a message will be more likely to apply simple decision rules (e.g., I can trust an expert). However, an individual who is able and motivated to process details will tend to use more effort and the analytic systematic mode.

The heuristic-systematic processing model (Chaiken 1980) assumes three broad motives: accuracy, defense, and impression motivation. An accuracy motivation tends to foster systematic processing in order that the individual holds accurate attitudes and beliefs (Chaiken 1980, 1987). A defense motivation reinforces important self-related beliefs through selectively processing information in a way that meets this need. An impression motivated individual expresses judgments as called for by the social situations in which they find themselves (Chaiken 1996) and may utilize either the heuristic or systematic mode. The model also recognizes that some individuals may have an absence of motivation (Chaiken 1996). These motives represent possible sources of bias and context effects in survey data. In other words, individuals with an accuracy motive are likely to seek to answer questions in an accurate fashion while individuals with a defense or impression motive may respond with a response that they feel to be safe and non-threatening.

In addition to motivation, an individual must also have the capacity to process information systematically. Ultimately, these antecedent variables result in a broad motive (accuracy, defense, and impression) which determines in part whether an individual uses heuristic or systematic processing of information. The information processing results in an attitude towards the information, a behavioral intention, and ultimately a behavior. In a survey context, the behavior may be nonresponse, response with accuracy, or a response with poor data quality due either to the defense motive or the impression motive.

Overview of Research Questions and Methods

As described above, the model suggests that individuals may use heuristic and/or systematic processing of information to form attitudes and behavioral intentions. The processing used is determined in part by the individual's motivation. Accuracy motivation, defense motivation, or impression motivation may motivate an individual. Dependent variables will be 1) self-selection of two types (type 1: nonresponse and type 2: dropouts under various treatment conditions) and 2) context effects or judgmental biases.

Research Question 1: The heuristic-systematic processing model predicts that when accuracy motivation is induced, a respondent will elaborate on the presented material with greater intensity (systematic processing). The common experimental treatment is to vary the personal relevance of the task or implications without suggesting a particular response. A literature search suggests that this relationship has not been applied to survey research. The question, then, is what effect does accuracy motivation have on nonresponse, drop out effects, and context effects.

Research Question 2: As noted in the heuristic-systematic processing model, the capacity to process information is necessary to use the systematic mode of processing. This capacity to process information may be hindered by the vast amount of information including text, graphical images, and banner ads present on each web page viewed. Thus, this clutter, or information overload, may represent a distraction to potential respondents and may reduce their ability to process information and increase their use of selective exposure. The result may be nonresponse or a tendency to use heuristic processing rather than the systematic processing desired for accurate responses. This path will be examined in the same method as Path 1 above, but with an additional condition: distracters, such as additional tasks to complete.

Research Question 3: The heuristic-systematic processing model predicts that when defense motivation is induced, a respondent will elaborate on the presented material with selectivity. In other words, respondents will choose to process and respond to material in such a way as to protect themselves. Respondents may desire protection when asked about a sensitive topic, when they question the purpose of a survey, or when they feel their privacy may be invaded. The question then is what effect does defense motivation have on nonresponse, drop out effects, and context effects.

Research Question 4: This path addresses the effect of impression motivation on the dependent variables. An impression motive may be induced if the individual is influenced by a perceived "audience." Individuals with an impression motivation processes presented material in such a way as to promote social goals. Thus, the result may be the presence of context effects.

References

Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology*, 39, 752-766.

Chaiken, S. (1987). The heuristic model of persuasion. In M.P. Zama, J.M. Olson, and C.P. Herman (Eds) *Social influence: The Ontario Symposium*, 5 (pp. 3-39) Hillsdale, NJ: Erlbaum.

Chaiken, S., Giner-Sorolla, R., & Chen, S. (1996). Beyond accuracy: Defense and impression motives in heuristic and systematic information processing. In P.M. Gollwitzer and J.A. Bargh (Eds) *The Psychology of action: Linking cognition and motivation to behavior* (pp. 553-578) New York: Guilford Press.

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High-Tech Solutions in Low-Tech Settings: A Distance Learning Initiative for Developing World Health Care Providers

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Abstract: In 1998, AVSC International, a nonprofit reproductive health agency working in over 25 developing world countries, began a three-year pilot project to explore potential applications of computer-based clinical training in low-resource clinics and hospitals. This paper describes the project and defines the content, technical, and administrative problems faced in developing and field testing materials on infection prevention during the first and second years of the project.

Introduction

Staff training has continually been identified as a priority need in developing world health facilities. These institutions have a strong, on-going need to train more health care workers, to maximize scarce training resources, to cut down on classroom time that interferes with the provision of services, and to decrease the costs associated with centralized training. There is also a clear need for systems that allow practicing medical staff to obtain technical updates and continuing medical education, as well as for training opportunities that arise as needed ("just-in-time" training) as opposed to centralized training that is attended just in case it is needed.

Distance learning, delivered to health care workers through laptops, desktops, or over the Internet, has the potential to help meet these training needs in a way that is continuous, on-site, and interactive. However, because of the significant challenges posed by the limited computer availability and limited Internet access, very little has been done to attempt to reach this audience with computer-based training methods. Believing that CBT has enormous implications for the future reach of health education in the developing world, AVSC International has undertaken a three-year project to investigate the delivery of Internet- and CD-ROM-based health education in these settings. This paper describes the activities in the first year and a half of the project, which has focused on materials development and field testing, as well as on developing training approaches and forging partnerships with national and local health care institutions toward the institutionalization of technology-based approaches to training in these settings.

Materials Development and Training Approaches

Content Selection

There were three primary criteria in selecting the content for the first phase of the project: 1) that it be on a critical topic relevant and appropriate to a global audience of health providers in settings ranging from large urban hospitals to small, rural clinics; 2) that it be in an area that lends itself well to a self-instructional format; and 3) that it be on a topic on which paper-based training materials for this audience had already been prepared and field tested. The topic of infection prevention was selected as meeting all three requirements. Adequate infection prevention, which is crucial to the safety of all health workers and their clients, is a particularly important topic for the target audience: with limited staff, training, equipment, and funds, developing world health facilities are, unfortunately, ideal settings for transmission of deadly diseases, such as HIV and hepatitis B infection. This topic is particularly well-suited for self-instruction, since the content is largely knowledge-based, and most of the skills-based content (such as procedures for instrument processing, surgical scrub, and gloving) can be easily conveyed through video or still illustration. In addition, adequate material for repurposing was available: at the beginning of the project, AVSC had just completed field testing of a comprehensive, global curriculum on infection prevention in Africa and Asia.

Training Delivery Models and Course Design

While it can be said that the Internet is becoming truly global, connectivity and hardware in developing world health facilities range from state-of-the-art to nonexistent. While some countries maintain access to all Internet protocols, others are limited to e-

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mail only. In some countries, Internet connectivity can be achieved by telephone; in others, Internet users must rely on satellite or radio technology, bypassing unreliable or nonexistent telephone services. Although computers are slowly becoming more widely available, in many cases, access is limited to the "technological elite" of international corporations, governments, and universities. Even when computers and Internet connectivity are available, unreliable electricity or telephone services can render equipment and ISP services unusable for significant periods of time.

To meet these challenges and to accommodate the widest possible number of users demanded the development of highly flexible products and delivery models. AVSC developed four products (a CD-ROM, a reference booklet as a "leave-behind" for users who would have only temporary access to the CD-ROM, a Web-based course, and an instruction booklet with guidelines and training activities for online trainers) and four scenarios for training delivery: 1) instructor-led asynchronous Internet training for pre-defined groups of learners with individual e-mail accounts and fairly reliable Internet access; 2) self-instructional Web training for individual learners with occasional access to the Internet; 3) self-instructional CD-ROM (with reference booklet) for use on a trainer-supplied laptop while the trainer is conducting one-on-one clinical skills training with other staff; and 4) self-instructional CD-ROM (with reference booklet) for learners with access to a stand-alone computer.

Both the CD-ROM and the Web course have a simple, modular design, with content focused on low-cost strategies for assessing and improving existing infection prevention practices. The CD-ROM, which is designed to provide approximately two hours of instruction when used as part of a clinical training, presents a broad overview of infection prevention and presents training content in six critical areas. The Web-based course covers the same topics, but does so in much greater detail and is more centered on immediate and practical application of the material within a clinic setting. For example, in the Web course, each module is accompanied by a "Making It Work" section which contains a package of materials optimized for printing - including skills checklists, signs and posters, implementation guidelines, educational aids, practice surveys, and instructions for building devices such as an oil-drum incinerator or waste-disposal pit.

Because it was designed for users who do not regularly have access to a computer, the greatest design challenge for the CD-ROM was to develop a lively, interesting product with navigation simple enough for users with little or no computer experience which, at the same time, would not be tedious for more experienced users. In the Web course, the greatest challenge was to present interesting visual content and interactivity while adhering to universal accessibility standards.

Each of the four delivery scenarios has both advantages and drawbacks. For example, the asynchronous, instructor-led Web course allows the trainer to reach a far-flung group of learners, tailor the course to individual needs, facilitate group discussions and training activities, gauge knowledge transfer, and provide focused, individual attention to learners. However, the amount of individual instruction needed demands a small training group, and the requirements of an individual e-mail account and reliable internet connectivity are additional limiting factors. Although the CD-ROM product is more interactive, more visually stimulating, and easier to use than the Web course, it is also less comprehensive in scope and more expensive to produce.

Initial Field Testing and Evaluation

The diversity of training products and delivery models has also presented challenges for evaluation and field testing of the products. During field testing, the project's focus is on measuring knowledge transfer, user satisfaction, ease of use, and individual sites' current technical capacity to deliver computer-based instruction. Testing is being conducted through a combination of pre- and post-tests, electronic data collection, user surveys, direct observation, and interviews. Field tests of the CD-ROM product are being conducted in collaboration with in-country partner institutions during regular clinical training sessions with a goal of laying the groundwork for future collaborations regarding the use of instructional technology to enhance service delivery. At this point, mid-way through year two of the project, data from the first instructor-led Web course is being compiled, as is the data from the first field test of the CD-ROM product, which was conducted with doctors, nurses, and trainers from four institutions in Nepal (including a medical college, an association of private practice doctors, a group of medical trainers, and medical staff of a family planning clinic). Plans for additional testing of both products are currently underway.

For the online Web course, the initial group of participants was notable in that it consisted of 20 self-selected participants (15 doctors, three nurses, and two representatives of international health agencies) from 14 countries (Brazil, Colombia, Egypt, England, Republic of Georgia, India, Mexico, Nigeria, Pakistan, the Philippines, Tanzania, Thailand, United States, and Zambia) who responded to a request for beta testers for the site. It is also notable that five of these participants encountered serious technical problems with their Internet or telephone service during the first two weeks of the four-week course and were forced to drop out. During subsequent testing of the instructor-led course, participant groups will be more narrowly defined, and testing will be conducted in collaboration with in-country partner institutions.

The current explosion of information technology presents numerous challenges and possibilities for public health in the developing world. While the enormous growth in this technology in the developed world threatens to further deepen existing inequalities, it also holds out the promise of improved access to education, health care, and information.

Creating Multimedia Learning Environments for the World Wide Web Using SMIL Technology

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Abstract: Synchronized Multimedia Integration Language (SMIL) became a W3C standard in 1998 and greatly facilitated the production of web-based multimedia applications. SMIL enables precise synchronization of streaming video, audio, text and images over the web, and streamlines the creation of effective multimedia learning environments. This paper presents and example of a web-based presentation made for a Neuroscience course and discusses production and implementation issues.

Introduction

This short paper describes a new technology that greatly facilitates creating multimedia learning environments for the World Wide Web: the Synchronized Multimedia Integration Language (SMIL). With escalating use of the WWW in education, instructors have been exploring the use of multimedia on the web to promote educational outcomes. Synchronized, hyperlinked multimedia ("hypermedia") could represent content in an engaging and meaningful way for students. Specifically, hypermedia could stress the conceptual inter-relatedness of ideas, provide multiple representations of the content, and could position the information in a real-life context (Hall, 1998, Jonassen, et al. 1997).

Until recently, creating web-based multimedia presentations was cumbersome. Synchronizing sound and images, for instance, required tedious editing and extensive JavaScript programming. This, however, has begun to change. During 1998, two industry standards were accepted that would open new avenues to effective multimedia development. First, the W3C approved SMIL (pronounced "smile") for multimedia integration and layout on the Web. Secondly, Real Time Streaming Protocol (RTSP) became the IETF standard for client-server transport of audio and video.

What is Synchronized Multimedia Integration Language (SMIL)?

With the introduction of SMIL a web developer can now become an effective "choreographer" of multimedia. SMIL gives a developer the ability to synchronize text, images, audio, and even video over the Web. A typical SMIL presentation consists of several components. Each component can be of a different media type and can be combined with simple HTML-like coding. Like an orchestra conductor, SMIL determines when each component starts and stops playing. For example, a particular image can be displayed only at the time during which the narrator in a video describes a certain topic.

One feature that makes a SMIL application particularly powerful is the ability to create hyperlinked hotspots on images, text and even on videos. These hyperlinks could launch a different SMIL presentation, jump forward or backward in the current presentation, or open a new website in the browser. For instance, by using hyperlinks, a video-on-demand interface can be created. Figure 1 illustrates a video-on-demand application developed at UCLA that includes video, images, text, and hyperlinks. SMIL documents are best displayed with Real-Time Streaming Protocol (RTSP), developed by Netscape®, RealNetworks®, and Columbia University. With client software such as the RealPlayer G2™ one can view a SMIL document using VCR-like controls ("play", "pause", "fast forward", and "rewind"). In addition, it is possible to embed a SMIL presentation in a webpage without the need of launching RealPlayer as a separate application.

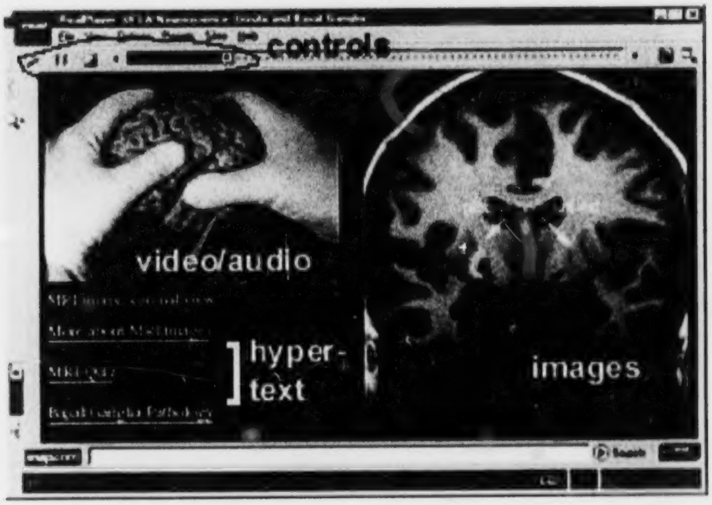

Figure 1: SMIL multimedia presentation including video, audio, images, hypertext and play controls.

How are SMIL presentations created?

SMIL is a straightforward, XML-based mark-up language, similar to HTML. Developers can use a simple text editor to write SMIL files or use specialized authoring programs. These authoring programs serve several purposes. First, they create the SMIL files in which the content, the layout, and sequencing of the multimedia components are coded. Secondly, these applications encode images, audio, video, and text in the appropriate format compatible with RTSP.

How are SMIL presentations implemented?

During this short paper presentation, an example SMIL application made for a Neuroscience course will be demonstrated. This application includes a video of a brain dissection, synchronized images and hypertext. The text and images appear and disappear depending upon the content of the video. We will address implementation issues, such as bandwidth issues, limitations, costs, and required programming expertise.

Conclusion

SMIL provides educational web developers with a powerful tool for creating effective multimedia learning environments. By virtue of the transparent nature of the SMIL language and of the relatively low start-up costs, web-based multimedia presentation can now be easily developed and implemented.

References

Hall, R.H. (1998). A theory-driven model for the web-enhanced educational psychology class. Paper presented at the Annual Meeting of the American Educational Research Association, April 13-17, 1998, San Diego, CA

Jonassen, D.H., Dyer, D., Peters, K., Robinson, T., Harvey, D., King, M. & Loughner, P (1997). Cognitive flexibility hypertexts on the Web: Enaging learners in meaning making. In: B.H. Kahn (ed) Web-based Instruction, Englewood Cliffs, NY: Educational Technology Publications.

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Tools for a Design, Development and Management of Multidisciplinary Multimedia Web-Based Courses

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Abstract: Web-Based Education (WBE) is a new teaching medium. This means learning new skills, new teaching methods and practices, and gaining a fresh outlook. Becoming familiar with a variety of tools for WBE (WBE tools) is a good first step for a design and development of Web-based curricula and courses. This paper 1) presents a list of several available WBE tools, and 2) describes the methodology and selection process of tools for a design and development of multidisciplinary multimedia WBE courses that provided best fit for instructors of the OMI College of Applied Science (OCAS), University of Cincinnati, OH, USA.

1. Introduction

WBE is the largest growing segment of higher and corporate education today. With the increasingly tight demands on people's schedules, and the need for continuing education to advance in the workplace, the ability to take courses via the Internet that fit into their lifestyle is attracting an unprecedented influx of students to colleges and universities worldwide. Experts say that 1) the number of WBE students will more than triple in the next three years, and 2) the cost of WBE may be as low as 25% of traditional classroom-based education. Studies show that "WBE students perform as well as, or better than, those in traditional classrooms" [http://tenb.mta.ca/phenom/phenom.html]. "Participation increases, retention is higher, and they're prone to express their ideas more often and in greater depth. WBE instructors are able to offer more personal and detailed guidance than in a traditional classroom, and they can do it unbound from a strict class schedule" [Martin 97].

2. Tools for Web-Based Education

Between April 1, 1998 and May 31, 1999, the members of the OCAS Distance Education Committee (OCAS DEC) and other OCAS computer professionals searched the Web, a huge number of periodicals, monographs, and conference proceedings in search of an application to deliver multidisciplinary multimedia Web-based courses to OCAS students in variety of technological areas such as Information Engineering Technology (IET), Mechanical Engineering Technology (MET), Chemical Technology (ChemT), Fire Science, and Humanities and Social Science.

The members of OCAS DEC performed a research on multiple features and capabilities of WBE tools that help to design, develop, maintain and manage multidisciplinary WBE curricula and courses. Vendors were contacted for demo versions of products. The members of OCAS DEC met regularly to discuss various WBE-related issues, and, specifically, advantages, disadvantages, features, and problems encountered during pilot course creation. More than twenty available WBE tools were selected for analysis on the first stage of research. They were ToolBook Assistant/Librarian [www.asymetrix.com], AuthorWare [www.macromedia.com], ClassWare [classware.uc.edu], Convene [www.convene.com], CourseInfo [www.blackboard.net/courseinfo], Director [www.macromedia.com], FirstClass Collaborative Classroom [www.education.softarc.com], Front Page'98 [www.microsoft.com], Intrakal [www.anlon.com], Learning Space [www.lotus.com/learningspace], MentorWare [www.mentorware.com], TopClass [www.wbtsystems.comindex.html], Virtual-U [virtual-u.cs.sfu.ca/vuweb], Web Course in a Box [www.madduck. com/webinfo.web.html], WebCT [www.webct.com], Webmentor Enterprise [avilar.adasoft.com], as well as Norton Connect, Allaire Forum, Team Wave, WebBoard, QuestionMark, and PlaceWare.

3. Selection Methodology

To analyze the above-mentioned WBE tools, OCAS DEC used a) available general [Gray 98] and b) additional particular criteria that are critical for the OCAS multidisciplinary multimedia Web-based courses. The list of criteria included but was not limited to

- **3.1. WBE tools for various technological areas (or, in other words, multidisciplinary aspect of WBE tools)** such as Information Engineering Technology, Mechanical Engineering Technology, Chemical Technology, Electrical Engineering Technology, Fire Science, and Humanities and Social Science;
- **3.2. WBE tools for instructors with variety of backgrounds** such as 1) with background in Computer Science , 2) with no computer background at all;
- **3.3. WBE tool purpose**: 1) a tool for WBE course's design and development, 2) a tool for WBE courses' management, and 3) a tool for various types of WBE collaboration and communication;
- **3.4. Instructor tools for WBE**: 1) course planning, 2) course managing, 3) rapid course revising and modification, 4) easy course monitoring, 5) course templates and tools for easy lesson design and development, 6) instructor-created sample courses, 7) tools for presentations, 8) variety of available libraries of icons, images, pictures, audio and video files, and 9) specific search engines;
- **3.5. Student tools for WBE**: 1) self-assessing tools, 2) progress tracking, 3) motivation building tools (to build student own home pages without any HTML knowledge), and 4) tools for study skill building (i.e. grades online, change of passwords online, online note taking, study-guide generation of topics selected by student);
- **3.6. WBE course communication features (or, in other words, multimedia aspect of WBE tools)**: asynchronous sharing such as 1) email (one-to-one and one-to-many), 2) discussion facilities via searchable threaded bulletin board system (BBS), 3) newsgroup facility, and synchronous sharing such as 4) discussion facilities via electronic chat room, moderated online teamware, and group discussion board, 5) shared whiteboard, 6) video conferencing, 7) audio conferencing, 9) data conferencing or file sharing;
- **3.7. WBE course management features**: 1) automated calendaring system and automated reminder system, 2) student online testing and automated grading, 3) student activity summary report and online gradebook, 4) timed quizzes/midterms/tests/final exams, 5) office hour facility, and 6) variety of class lists, 7) online student and instructor manuals, and online help system;
- **3.8. WBE course administrative features**: 1) variety of levels of security, 2) online technical support, and 3) student honesty checking;
- **3.9. WBE tools technical requirements:** 1) requirements for server platform (RAM, disk space, operating system, etc.), 2) requirements for client platform (minimal level), and 3) limitations of WBE tool;
- **3.10.WBE tools pricing:** 1) prices, 2) number of student accounts per copy of WBE tool, 3) educational discounts, 4) availability of free demo version on the Web, and 5) extra considerations.

4. Findings

On a basis of results of performed research and completed search:

1. The OCAS DEC decided that currently there is no single WBE tool that is optimal for OCAS and meets all of OCAS above-mentioned criteria, requirements and expectations.
2. The great variety of available WBE tools was reduced to several tools for further careful in-depth consideration. The following WBE tools were recommended for utilization in OCAS WBE-related activities:
   - a) WBE tools for instructors with strong background in the Computer Science area and, specifically, for the newly established Information Engineering Technology (IET) degree program [Uskov&Saad&Uskova98]: WebCT, Asymetrix ToolBook II Librarian, and Macromedia Director tools;
   - b) WBE tools for instructors with no computer background: Macromedia AuthorWare, ClassWare, WebCT, and Asymetrix ToolBook II Assistant tools.

5. References

[Martin 97] Martin, B., et al. (1997). How To Design and Manage a Successful DE Course. *ASEE Prizm*, Feb'97, pp.18-22.

[Gray 98] Gray, S. (1998). Web-based Instructional Tools. *Syllabus*, Vol. 12, No. 2, 18-19.

[Uskov&Saad&Uskova 98] Uskov, V., Saad, A. & Uskova, M. (1998). New Degree Program on Information Engineering Technology at the University of Cincinnati with Distance Education Component. *The Proceedings of the 1998 Frontiers in Education Conference*, Tempe, AZ, p. 330.

Integrating Administration with a Learning Environment on the Web – Case Study

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Abstract: The Open University of Helsinki provides a learning environment and virtual courses as an alternative to traditional teaching. The project began as plain HTML pages in January 1998 and has gradually evolved into a comprehensive learning environment adapted to accommodate for our needs in course administration. This paper provides an overview of our learning environment and its uses.

Overview

Virtual courses and environments are becoming a necessity for all self-respecting educational institutions, and many already offer virtual courses as part of their repertoire. A lot has, and is, being said about how to design the courses and how they enhance (or hinder) the study process. New learning environments and applications, each better than the previous ones, are emerging on the market and promise integration of traditional teaching techniques with the Web.

However, ready-made applications and learning environments often have many kinds of restrictions on what can be done, and how. Indeed, organizations usually have to adapt their own process to that of the application software. Also, software is mostly centered on virtual courses, whereas other supplementary processes are often neglected.

The purpose of this paper is to promote integration of administrative processes with the learning environment, and present our solution as an example and basis for discussion. Instead of designing a virtual course, organizations could adapt the whole process to the Web, leading the student from idea to completion.

Student's View: Inside the Learning Environment

The open university is open to all, regardless of age and educational background. The teaching is equivalent to basic university teaching, and is offered at low cost by law. All goals of study are equal to universities and all study is part-time. The Open University of Helsinki has 25,000 students and 17 years of experience in distance education. It is not a separate educational organization, but part of the University of Helsinki which is the largest university in Finland.

Our Web service is a comprehensive environment that provides most of our basic services. Information is accessible anytime anywhere, and student counseling has actually been enriched by the Web: students can e-mail their questions or check our frequently asked questions lists to get answers. Tutoring pages offer information about the requirements for access to open universities and facts about assessment, virtual courses for improving study skills, and stories of experienced students. Even online counseling is possible at set hours.

Additional services are open for users who have joined in as members of our Web service. Membership is free and instantly available to everyone by filling in a registration form. Membership services center around the Student Club providing less formal services for students: local e-mail (inMail), student introductions, and discussion groups. Membership grants access to all exam results and various self-study materials. The purpose of the Web membership is to socialize students, encourage frequent use, and personalize our service.

Members can enroll on our virtual courses which are show-cased on the Web. Enrollment is possible through a Web form if there's room on the course (up-to-date status is displayed in the show-case; some course groups even allow queuing). After registration the student is informed of what steps to take next; whether she's to wait for an opening on the course or to pay the study fee. Currently study fees cannot be paid on the Web, but we have plans of including that option this year. When the study fee has been paid the student is granted access to the course and informed of the course details. If placed in the queue, the student will be notified automatically by e-mail when there's an opening on the course and provided with instructions on how to proceed.

In the beginning of 1999, we offered 20 virtual courses ranging from Computer Science to Theology. Some courses can take an unlimited number of participants, whereas others have a set number of students per group. Some can be studied all the time, while others have groups beginning at set intervals.

Because the study process is different on each virtual course, each course has been tailored individually to meet the pedagogical and didactical needs for the particular subject. Some of the courses are a combination of different forms; The Web, Classroom Teaching and Group Work. Sometimes the interactive part of learning is going on in discussion groups or study diaries, other courses lay stress on written materials and links, and some add audio/videoconferencing or face-to-face sessions.

Most courses still require a written test that cannot be taken on the Web (restriction set by university administration). Students have to sign up for tests, and for virtual courses that is done solely on the Web. Students post a pre-filled form and are then informed of their status, whether they can participate in the test or whether they'll have to pay a registration fee (some tests require an additional fee). When the student has successfully completed the course, the results are posted on the Web in the student club. After completing a virtual course the student is asked to fill out an evaluation form that is sent to our research team for analysis.

Administrative View: Interfacing with the System

All personnel interacts with the system through a Web browser with specific tools designed to manage the study process. InMail or Internet mail can be sent to certain subsets of our Web members (by course, group, test, payment status etc.). Naturally we also have tools for administering memberships (accounts, passwords, user information), course information, course enrollment, and exam sign-up. The system manages course dates, informing students about the date they'll be allowed access and warning them two weeks in advance about the expiration of their course access. The same process is applied to course and exam sign-up which expire if the student hasn't paid the study fee within two weeks of sign-up. Exam supervisors and teachers are automatically notified when exams are due for processing. And in addition to virtual course sign-up, it is also possible to sign-up for normal exams on the Web. However, at the moment only virtual courses are handled automatically.

All courses are individually tailored by our Web team, with a research team contributing to the course development process. Course design tools are not yet provided for the teachers since course production and updating usually requires programming or HTML coding. Pure text updates are actually quite rare, and teachers haven't expressed much interest in learning to design Web pages themselves. However, we are developing a course design package to combine course production unity, flexibility, and high class editing work with easy modification possibilities for the teachers.

Our course design team has several common tools at their disposal, e.g. inMail, notebook & study diary, discussion groups, and course calendar. In addition, different exercise applications have been developed for individual courses and can easily be adapted to other purposes (e.g. multiple choice tests, automatic feedback). For research purposes, we can obtain individual session paths from our Web server log to study individual students' actions anonymously. Other statistical data can also be computed from the log.

Conclusion

Instead of choosing from commercial applications, we decided to implement the learning environment ourselves. That enabled us to have total control of all the details, including system language, course design process, page layout and structure, and administrative processes. The main emphasis was on custom-tailoring, flexibility, and continuing development process. The learning environment development is done by a full-time, closely collaborating Web research and development team consisting of content specialists, researchers and experts in programming and systems design, Web design and layout, and Web-based learning processes.

The road that we have chosen may not be the easiest. Indeed, it does require a lot of work and involvement from the whole team. We need to have people working on Web projects full-time and a programmer / systems designer devoted to the project. But on the other hand, this process has taught us a lot about Web environments and made their use easier for our personnel since they get to participate in the process of implementing their work routines on the Web. The end result is a flexible environment that matches our needs and can easily be modified to include new cutting edge techniques, helps personnel do their work more effectively, and covers the whole process students need to go through for studying.

The CATCHUM Consortium: Developing a Cancer Prevention Curriculum using the World Wide Web

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Introduction

A website can serve many functions for different organizations. Some will use it for publicity, some for commerce, some for learning and training and a few for all these purposes. The following case study shows how a statewide network of institutions has designed a website as a tool for collaborative efforts, for sharing of resources, and for dissemination of consortium-developed products.

Case study

The Cancer Teaching and Curriculum Enhancement in Undergraduate Medicine project (CATCHUM) is a grant funded effort with the goal of developing a cancer prevention curriculum for undergraduate medicine. To achieve this goal, CATCHUM activities are developed through a consortium consisting of eight medical institutions in the State of Texas. Faculty and staff from each of these eight medical institutions were nominated to the various task forces of CATCHUM depending on their area of expertise. CATCHUM is the only consortium-based project involving all the medical institutions in the state. Collaboration and resource sharing are the main key to the success of this project. To achieve project goals, faculty with multiple areas of expertise voluntarily joined their intellect and knowledge of content and technology to devise innovative approaches to advancing cancer prevention and control. Early on, the consortium saw the utility of the Internet and the World Wide Web as a means to publicize CATCHUM, to disseminate CATCHUM created products, and to collect data. Although the earlier website served these purposes, over time it became apparent that the basic structure of the site needed improvement.

The Educational Technology Task Force (ETTF) was charged with revising the website into one that was more interactive and user-friendly. The objectives of the website are to provide clinicians, faculty, and undergraduate medical students, with an easier access to information on cancer prevention and clinical screening. A professional web developer designed and developed the CATCHUM website in conjunction with the ETTF. The website (http://www.catchum.utmb.edu) contains background information on the project and explains the rationale and need for developing a cancer prevention curriculum in undergraduate medicine. It also provides information on the various task forces and educational resources.

The CATCHUM website has greatly assisted with collaboration and resource sharing. An important use of the website is to distribute Objective Structured Clinical Exam (OSCE) case studies. These are cancer-related case studies that have been developed by CATCHUM members to be used in teaching medical students. Having this information on the web makes it easy for any medical school, regardless of where they are located, to have access to it at any time. There is a concerted effort at present by all the medical schools in the consortium to incorporate some or all of these cases into their curriculum. The development of OSCEs has since been suspended temporarily and given way to the development of Problem Based Learning (PBL) cases that also will be available from the CATCHUM website. Some medical schools in the consortium are planning to incorporate the first four developed PBL cases into their curriculum in Fall 1999. Collaboration and resource sharing was facilitated by the CATCHUM website when developing Standardized Assessment Project (SAP) Exams. Students from all the medical schools in the consortium tested the exams on-line. Using the website to deliver and collect the exams held advantages over attempting to deliver and collect paper tests. The question bank has been updated and students from all the medical schools in the consortium can register on-line in order to take the original SAP exams. The newly developed exams are only available to faculty with prior approval at this time.

The website has proven to be helpful to instructors responsible for teaching medical students as it contains lectures and Power Point presentations on various topics related to cancer. Faculty from the medical schools in the consortium, are encouraged to look at other's lectures and to add their own to the CATCHUM website. There is also a Related Links page, which connects educators to a number of websites worldwide, related to cancer prevention and control. Other resources include the newly developed cancer education modules for the community preceptors, who are physicians in the community training medical students in their setting. These modules consist of cancer prevention and control information for physicians to educate and evaluate medical students under their supervision. These modules will be available for download in Fall 1999.

For the members of the various task forces, there are restricted areas on the website that provide them a place to communicate, to collaborate, and to post documents prior to making them publicly available on the website. Publicity on CATCHUM's website and its potential for students and faculty will be done through members of the Steering Committee, who will hold meetings with the faculty champions in their medical school. Faculty Champions are faculty who have been identified in each Texas medical school to promote an awareness in incorporating information related to cancer prevention and control into their curriculum. The faculty in turn will encourage their students to utilize the information found on the CATCHUM website to improve their knowledge base in cancer education.

Conclusion

In looking to the near future, CATCHUM envisions many possible uses for their website. One is to develop cancer related web-based clinical cases for students to review. The visual aspects and the interactive environment will enable students to show an active interest in cancer prevention and control. The other is to develop an interactive cancer risk assessment tool with a questionnaire for the students to complete and be reviewed instantly. Every effort will be made to make the modules interactive and user-friendly.

As Douglas Engelbart (1995) rightly pointed out that collaboration is the key to the success of any innovative undertaking because of the expertise that the members of a team bring to the table. No single person can hope to achieve the same degree of success as that of a team. Having said that, medical education is clearly catching onto this idea of a consortium-based environment for conducting projects, which will ultimately have an impact on the medical school curriculum. It is clear that the web will play a pivotal role in promoting CATCHUM's goals of developing a cancer prevention curriculum in undergraduate medicine, in the near future.

References

Engelbart, D.C. (1995). Dreaming of the future. *Byte*, 20, 330.

Knowledge Management in Education

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Abstract: Knowledge Management is the set of practices and technology that leverages the value-added information that is mission-critical for organizations.
Every school has a wealth of intellectual capital and experiences. Although it is of the highest value, this 'corporate asset' is also the most under-utilized. Teachers of different subject don't know the way of teaching of each other. Teachers can help teachers of their own school and of other schools. How can they exchange knowledge and best practices? How can they find the right information for their job in the right time? There is a growing need for an interactive knowledge bank for primary and secondary education, based on practical experiences.

Information

Primary schools in the Netherlands cater for children from four to twelve years of age. They are usually arranged into eight year-groups. Attainment targets have been formulated indicating the basic minimum that schools are required by law to teach their pupils in each area of the curriculum. However, schools have considerable freedom in the choice of course books and materials and they can also add their own emphases to the curriculum.
Secondary education changes from 1 August 1999. The main developments in secondary education relate to teaching itself. There are three interconnected aims: to further the broad personal development of all pupils, to promote an active and independent attitude towards learning and to cater for differences between pupils. These aims are the constant motif running through the recent reforms of the curriculum.
For each subject, the government has formulated new attainment targets defining the knowledge and skills which pupils must have acquired by the end of the period of basic secondary education. In these attainment targets, the emphasis is on coherence, particularly between the education provided and the pupil's own world. In addition, schools are given scope to cater for the differences between pupils. General educational objectives have also been formulated. These are not subject-based like the attainment targets but are cross-disciplinary objectives relating to social issues and skills. These general educational objectives are a compulsory aspect of basic secondary education, although how they can best be addressed is a matter, which is left to the subject departments in the individual school to agree amongst themselves.
All these reforms ask much of teachers and school heads. They are searching for any and all information that can help them get their jobs done and achieve their organizations' business objectives. Universities, national advisory centers, and other educational institutes give information, write papers, give courses, make lesson plans, and so on. But which course fits the lack of knowledge of a certain teacher in vocational secondary education teaching motor mechanics, caring occupations or commerce? A thematic interactive knowledge bank will help to find the way in the information rush. The interactive knowledge bank, accessible in several ways, will include questions, problems, traps, solutions, bench marks and best practices.

Knowledge

Information isn't knowledge until people add value to it, transforming raw data into advantages. Accessing and sharing information are only the beginning of the knowledge transformation process. Gradually, experience is growing in building knowledge systems to get improved achievements. Using ICT plays an important role in this. But, up to now, the role of ICT has been little more than a collection of electronic instruments for developing, establishing, and integrating knowledge and abilities within an organization. Many existing knowledge banks are therefore actually nothing more than automated filing cabinets. Knowledge and questions of people looking for answers themselves are not used. The results of these kinds of systems are disappointing. Modern knowledge systems, aimed at efficiency, take advantage of the practical expertise of professionals and of the questions they ask. A network of teachers or school managers, who are learning in an interactive way, combines the learning opportunities of interaction in networks with the chances that ICT offers to make the knowledge of people explicit, as well as to record and to distribute it. In such a way, more aimed, better-equipped, and more effective networks can be established. A combination of physical and virtual networks, ranging the complete scale of necessary interactive knowledge activities: elucidating, making explicit, development, recording, filing, distribution and use.

New forms of learning in a school organization and an ever more critical environment ask for the development of learning networks. Networks of professionals who are to shape and give meaning to a new kind of learning. Much knowledge can be generated from the interaction among people with practical experiences. In these traditional networks the exchange and development of knowledge often remains among the participants. Another disadvantage is that the goals of these networks and with this the developed knowledge are often not connected with the goals and organization of the schools.

The success of personal (physical) networks of teachers and schools is indicative for the possible success of a virtual learning community.

Collaborative Knowledge Development

People taking action and working together to create projects, form teams, develop project deliverables, and manage projects and processes through their many stages and cycles. Capitalizing on your collective knowledge and intellectual assets takes more than a repository, some search and document management functionality. It takes collaborative knowledge management-a complete knowledge management system that addresses all elements of the knowledge process.

Coming years a knowledge management system for teachers in primary and secondary education in the Netherlands will be developed on Internet. It will be a portal to a mix of downloadable publications, courses, best practices, links to other web sites, theme discussion forums, all structured on a new way round profiles of functions and tasks. The Knowledge system for Education will be a thematic interactive knowledge bank, combined with other features as discussion groups on specific educational and organizational themes, coaching network members on the job by professional counselors, on-line fraternal consultation in a virtual staff room, and teleconferencing with experts on particular subject areas. The Knowledge system for Education will function as the carrier of a virtual work community through which teachers and school heads are to be given the opportunity to meet each other, to exchange thoughts, and where, on the basis of a personal knowledge and information profile, they can be referred to information and knowledge carriers, relevant to their work situation.

Applying the Hexa-C Metamodel of Instructional Theory and Design to Educational Web Applications

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Abstract: As the World Wide Web and Internet increasingly become delivery media and communication forums for educational purposes, guidelines for quality assurance of instructional sites should incorporate established principles of instructional theories, applied to these unique environments. Current directions and developments in learning theories and instructional design are overviewed and certain stances: cognitive science, constructivism, component-based instruction, customization, creativity, and collaboration, compositely called the Hexa-C Meta-model, are proposed as desirable characteristics of, and possible evaluation criteria for, educational web design.

1. Introduction

Developing materials for the World Wide Web (WWW) is fast and simple, bypassing the traditional processes of publishing and disseminating information. It is essential to maintain quality, particularly in sites and environments for teaching and learning. Instructional theories and instructional design were originated for text materials and later applied to computer-based products (de Villiers 1995; 1998). This paper relates such theories and practices to web-based applications, applying them to the specific characteristics of web-learning, but avoiding replication of print environments. The success of the WWW and Internet in education depends as much on instructional design as on technology (Cronje 1997). The paper overviews current instructional and learning theories, relates them to web design, and suggests six specific characteristics, compositely called the Hexa-C Metamodel, as desirable features of, and possible evaluation criteria for, instructional websites.

2. Learning Theories and Instructional Websites

Learning and instructional theories relate to the philosophy of education, whereas the discipline of instructional design (ID) defines characteristics of instructional products, aiming for optimal promotion of knowledge acquisition and skills in learners. ID proposes methodologies for the design and development of instructional media to make instruction effective, efficient and relevant. Various ID models exist (Reigeluth 1983; Wilson 1992; Merrill 1996), some being pragmatic definitions of instructural procedures, others based on instructional theory. Merrill (1996:6) defines instructional design as 'a technology for the development of learning experiences and environments which promote acquisition of specific knowledge and skills'. Reigeluth (1997) calls for clear links from learning theories to educational practice. There is increasing emphasis on instruction as the facilitation of learning, as well as imparting of knowledge - both roles in which the WWW can excel. Mehl (1993:13) states: 'The successful application of the computer in education is directly dependent upon instructional design ingenuity backed by a solid foundation in learning theory and learner research'. Judicious use of the WWW, based on relevant educational theories and appropriate ID principles, presents unique learning experiences.

3. The Hexa-C Metamodel of Instructional Theory and Design

The use of different theories in tandem is synergistic. This paper highlights six inter-related stances, referred to as the Hexa-C Metamodel, and discusses their impacts on instruction and learning. It is proposed that this model be applied, where appropriate, to provide guidelines for web-based learning sites and environments.

3.1 Cognitive science

Cognitive science relates to the reasoning and thinking processes as learners acquire knowledge and skills; it emphasizes active cognitive processing (Vockel 1989; Osman 1992). Perception and learning are viewed as reorganization of internal knowledge structures, as learners construct meaning by integrating new with existing knowledge (Inhelder & Piaget 1958) to facilitate comprehension and recall. Higher order thinking skills (HOTS) entail metacognition; critical and creative thinking; and the skills of classification, analysis and synthesis. In order to foster metacognition and facilitate active creation of schemata, cognitive features should be included in learning products. Particularly appropriate to web environments are chunking (classifying and linking information), concept-mapping (representations that show relationships), advance organizers (to introduce new material), bridging (linking from known information to new), rehearsal, graphic depictions, and mnemonics (to facilitate recall). Few traditional educational products emphasize cognitive strategies such as active planning and self-monitoring; instead, learners are viewed as passive participants under active instruction. Web-based learning, by contrast, fosters active, flexible learner-involvement.

3.2 Constructivism

Constructivism is based on learners actively constructing their own knowledge. Piaget was a constructivist! Key aspects (Dick 1991; 1996) are real-world situated learning, anchored instruction, discovery-learning, integrated testing, and transfer (applying known skills to new tasks). Constructivists object to criterion-referenced testing, preferring contextualized learning environments where learners set their own goals. The active learner participation required in constructivistic models can lead to long-term results and real-world performance. Grounded-constructivist learning environments (Hannafin 1997) are based on various theoretical frameworks, different learning contexts, and empirical research in human learning theory. Grounded design can be implemented in web-based learning, where heterogenous learners navigate through links, reaching destinations via personal discovery voyages. Web-based teaching and training facilitate learner initiative, knowledge construction, and real-world exposure via browsing. Graphic representations on the Internet facilitate learning-by-visualization.

3.3 Customization

Design of learning materials must change to meet the information age (Reigeluth 1997). A learning-focused paradigm requires customization to individual profiles and facilitation of learning, as well as presentation of material. Instructional media should be flexible, characterized by individualization, adaptability, and interactivity, so that learners take the initiative, using technologies, choosing between methods, and selecting the level of support. Customized learning caters for varied learning styles, giving learners control over the time, place and speed of their learning experiences. It is user-centred, facilitating access to new information on a just-in-time, need-to-know basis. Customized learning via the Internet has the further advantage of information that is current.

3.4 Creativity

Instruction and learning can be dull, prescriptive and formal (Dick 1995). Despite sound objectives, learning materials, though instructionally effective, may bore learners. The design of many current instructional packages, however, is characterized by innovative features and learner-engagement. Creative design (Dick 1995) entails learner-analysis to match specific interests and an instructional strategy that motivates, for example, Keller's (1987) ARCS model which advocates gaining attention, demonstrating relevance, instilling confidence and providing satisfaction. Instructional designers in vocational business training (Caropreso 1996), are also aware of the value of creativity, novelty and innovation in their products. As adults are exposed to the paradigm (or the threat?) of life-long learning, such features in materials contribute towards positive attitudes.

3.5 Component display theory (CDT) and transaction theory

Component Display Theory (Merrill 1983;1996) is based on Gagné's conditions of learning (Gagné 1985) and proposes that different instructional strategies are required to achieve different instructional goals. CDT classifies the performance required and the content to be taught - the performance categories being *remember*, *use* and *find*; and content categories, *fact*, *concept*, *procedure* and *principle*. Each instructional objective is classified by performance (strategy) and content, and the corresponding instructional component is placed in Merrill's 2-D performance-content matrix to show the degree of coverage of the required content and outcomes. Learners choose components, selecting the instructional strategy and the content. In selecting strategy, they control the presentation method, degree of elaboration, and number of examples. For content, they choose material appropriate to their personal style or level of learning. CDT's deconstruction of a domain into components is applicable to a variety of subjects and delivery media, but lends itself to computerized presentation of knowledge components. Computers should be used so as to capitalize on their unique capabilities, interaction and individualization, both of which are features of CDT, and can be effectively implemented in instruction and learning via the WWW and Internet.

3.6 Collaborative learning

Web pages are more static than CAI tutorials and simulations (coded in programming languages), and do not offer sensitive feedback and judgement. Yet the Internet holds great potential for interactivity of a different kind, namely collaborative learning, incorporating participative communication and spontaneous learner-input. Johnson (1991) proposes collaborative learning as a means of learning alone and together, with three prerequisites - a mutual goal, positive interdependence, and individual accountability. This entails a team approach where learners need each other's input to complete tasks, yet remain personally responsible and accountable. Schegel (1996) describes how the WWW presents a collaborative approach, yet without diminishing its potential for personalised, flexible learning. The Internet facilitates learner-learner and learner-facilitator communication, both in workstation teamwork and distributed virtual teams. Learners collaborate by e-mail, news groups, discussion boards, online conferencing, contributions to joint pages, and by editing peers'work. Appropriate design standards and ethics must, however, be upheld in all contributions. Collaborative learning is enriched by cross-discipline, cross-institution co-operation. Cronje (1997) describes Internet-based collaborative work, where distance-learners, geographically dispersed and communicating asynchronously, produce joint and individual products for assessment. Turoff (1995) describes the Virtual Class of the New Jersey Institute of Technology, where a remote degree programme is offered, replacing the physical class with an electronic virtual environment.

4. Conclusion

Teaching relates to the deconstruction of knowledge, and learning to the construction of knowledge. As instruction and learning migrate increasingly to the WWW and Internet, relevant aspects of expertise on human learning and ID models should be identified and applied to educational websites and Internet forums. The elements of the Hexa-C Metamodel: cognitive science, constructivism, customization, creativity, CDT and collaboration, are suggested as desirable characteristics for incorporation in the design and development of educational applications. Criteria for evaluation of electronic learning environments vary according to the nature and purpose of the application, and the Hexa-C Metamodel may be used, where appropriate, towards such quality assessment.

5. References

Caropreso, E.J. & Couch, R.A. (1996). Creativity and Innovation in Instructional Design and Development. *Educational Technology* 36 (6): 31-39.

Cronje, J. (1997). Interactive Internet: using the Internet to facilitate co-operative distance learning. *South African Journal of Higher Education* 11(2): 149-156.

De Villiers, M.R. (1995). *Integrating a software engineering approach and instructional factors in instructional software development, illustrated by a prototype in theoretical computer science.* MSc thesis, University of South Africa, Pretoria.

De Villiers, M.R. (1998). Instructional theories of experts: a practical implementation. *South African Journal of Higher Education* 12(2): 204-213.

Dick, W. (1991). An Instructional Designer's View of Construction. *Educational Technology* 31 (5): 41-44.

Dick, W. (1995). Instructional Design and Creativity: A Response to the Critics. *Educational Technology* 35 (4): 5-11.

Dick, W. (1996). The Dick and Carey model: will it survive the decade? *Educational Technology R & D*, 44(3): 55-63.

Gagné, R.M. (1985). *The conditions of learning*. New York: Holt, Rinehart and Weston.

Hannafin, M.J., Hannafin, K.M., Land, S.M. & Oliver, K. (1997). Grounded practice and the design of constructivist learning environments. *Educational Technology Research and Development*, 45(3): 101-117.

Inhelder, B. & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence.* New York: Basic Books Inc.

Johnson, D.W. & Johnson, R.T. (1991). *Learning together and alone.* Englewood Cliffs, NJ: Prentice Hall.

Keller, J.M. (1987). Strategies for stimulating the motivation to learn. *Performance and Instruction*, 26(8): 1-7.

Mehl, M.C. & Sinclair, A.J.L. (1993). Defining a context for CAI: in quest of educational reality, in *Computer-based education and training in South Africa,* edited by R.C. Lippert. Pretoria: J.L. van Schaik Publishers.

Merrill, M.D. (1983). Component display theory, in *Instructional design theories and models: an overview of their current status*, edited by C. M. Reigeluth. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Merrill, M.D., Drake, L., Lacy, M.J., Pratt, J. & ID_2 Research Group (1996). Reclaiming instructional design. *Educational Technology* 36 (5): 5-7.

Osman, M.E. & Hannafin, M.J. (1992). Metacognition research and theory: analysis and implications for instructional design. *Educational Technology R &D* 40 (2): 83-99.

Reigeluth, C.M. (Ed.) (1983). *Instructional-design theories and models: an overview of their current status*. Hillsdale N.J.: Lawrence Erlbaum Associates.

Reigeluth, C.M. (1997). Instructional theory, practitioner needs, and new directions: some reflections. *Educational Technology* 37 (1): 42-47.

Schlegel, K. (1996). *Why the Web?* Available:URL:http//www.netspot.unisa.edu.au/eduweb/Theory/theory.htm

Turoff, M. (1995). *Designing a Virtual Classroom.* Available:HTTP:http//www.njit.edu/CCCC/VC/Papers/Design.html

Vockell, E. & vanDeusen, R.M. (1989). *The computer and higher-order thinking skills.* Watsonville, CA: Mitchell Publishing.

Wilson, B. & Cole, P. (1992). A Review of Cognitive Teaching Models. *Educational Technology R & D* 39 (4): 47-64.

Online Experiments - Considerations and Possibilities

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Abstract: This paper describes work in progress in the area of connecting new, physical resources, like telescopes, cameras and other expensive (or rare) hardware to an online virtual shared environment. This paper is meant to inspire future developments and discusses design issues, both in terms of access control schemes and other CSCW aspects and in terms of software technologies like Java servlets and Java native interfaces.

1. Introduction

DELTA has, since 1995, been working with virtual classrooms and online learning and collaboration. Our virtual classroom is based on a college metaphor and is mostly centrally distributed, using web-technologies and mbone tools (see [1]).

We have integrated modular CSCW tools (shared whiteboard components, editor components, a virtual overhead projector etc.) in different virtual rooms to cater for different needs for asynchronous and synchronous CSCW (see [3]). Now, DELTA has embarked on a new area of research, namely methods and technologies for connecting new kinds of machines to the net. In terms of web-distributed teaching and learning, connecting different apparatus to the net gives the teacher the possibility to allow students to experiment with possibly quite expensive equipment, possibly very far away, in possibly very distributed groups. We have already seen telescopes - "wired" and remote controlled -monitored in virtual laboratories. So how about a remote controlled aquarium, with monitoring by mobile underwater webcams.

2. Connecting users to connected machines

In our design of web-connected apparatus, like a mobile camera and a shared web ISDN-Phone, several design issues have come up, which we want to share and discuss in this paragraph.

Traditionally, information sources on the web have been based on text and graphics. With the emergence of Internet CSCW tools, information sources can now be synchronous input from and collaboration with fellow students, teachers or co-workers. Now, technology furthermore allows us to put other sources of information on the net; cameras, instruments and even coffee-machines can be the originating source of information. The next step natural step - especially in the area of online education - is the sharing of and collaboration around these resources. Several issues for research and development must be addressed;

- implementation of coherent, usable virtual interface for "wired" machines
- collaboration in using and sharing of these machines
- design of software using good frameworks, to more easily address the "wiring" of new apparatus to the net

3. Interfaces for "wired apparatus"

Different applications of wired apparatus calls for different designs of interfaces to the apparatus.

Using web-technologies, we can limit and control exactly what information and what controls the user of a connected machine should have available. For instance, we have implemented simplified interfaces to both our web-connected phone and our moving web-camera. The web-camera, which is mounted with two separate servomotors allowing for two-dimensional panning, is controlled by simple mouse clicks on the image returned from the camera. The motors will then position the camera to focus on the spot where the user clicked. The web-phone is controlled by a simple html-based web-form.

Different design considerations should be applied when the purpose of the wired apparatus is to train the actual use of the camera; the interface should obviously be more representative of the real thing. Still, simplifications could allow for limited cognitive or perceptive "overhead" in the first phases of training.

A natural next step would be to create "meta-apparatus" or virtual machines. The same web technologies allowing us to join legacy software and database systems in unified web interfaces allows us to create actual collections of separate physical apparatus into coherent virtual machines. For instance, you could imagine a remote controlled aquarium in which you control both the dispensing of food, pumps for water flow and lighting - all through one, web-based interface.

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4. Collaborative use of "wired apparatus"

Several issues come up when wiring apparatus for collaborative use - especially access schemes and access restrictions are of great concern. For most apparatus controlling it in a kind of "anarchy mode", where all users can "push" buttons as they like, is not a suitable solution.

The problems that arise using, for example, anarchy mode in control are not only because of situations where two users try to "pull" the apparatus in opposite directions, but are also due to delayed response. The delayed response is caused by two factors; first of all the transit time from client to apparatus and back, secondly the time passed from the apparatus gets the request to when it actually shows that something has happened. If we are controlling the apparatus in anarchy mode, users will sometimes see an old state of the apparatus, due to the delay, and therefore may act from wrong assumptions about the state of the machine. In most cases you therefore need some kind of restrictions of simultaneous access. On the other hand if a trainer is training somebody to use the apparatus, it is important that transfer of control can be transferred between trainer and trainee quick and easy. And in some situations it could also be of use if the trainer could break in and take control.

Another issue about access is who at all is allowed to access the apparatus; if you have an astronomical telescope, you are probably not interested in all Internet surfers having free access to control it. Therefore you need some authentication and access control.
Another area of interest is awareness of other users, either controlling or "watching" the apparatus. It is important that users can see if another user has the control and maybe also who the other user is. It is also nice for the user controlling the apparatus to be aware of other users watching.
Besides the control and view of the apparatus other tools for collaboration can be of interest in a wired apparatus application. E.g. tools for communication between the users, such as chat tools and videoconferencing tools.

5. Technologies used

This paragraph briefly describes the different technologies we see as operational in connection to putting new machines on the Internet.

DELTA's CSCW server and our CSCW tools are all implemented using Java (see [2]). Therefore, it was natural for us to concentrate on the use of Java (Applets, Servlets, etc.) in connection with "wiring" machines for use on the net.

Machine Layer: The software layer "closest" to the machine typically has to be written in C or C++. Using the Java Native Interface definition, we have developed an Java API for communication with an ISDN card. Control of servomotors for our webcam could be implemented using the standard Java communication extensions (javax.comm classes).
Server Layer: Java servlets allows us to program server functionality that is both easily developed and easily maintained. Servlets - in contrast to CGI-scripts for instance - can maintain a state, use several threads of execution, and be dynamically updated. A change in a utility or control class, can, due to Java's dynamic linking feature, be implemented just by uploading the new code. For creation of CSCW tools and "awareness" features, servlets also seems like a good technology, as they can continue to run between execution, and that new threads (that can be made to intercommunicate) are automatically being created for each new user invoking the servlet.
User layer: The user interface, naturally, is based on web-technologies like Java Applets, Javascript and HTML. The interface for our ISDN-phone is simply form-based, whereas our web-cam is far more advanced, and uses a combination of forms, javascript and a java applet.

6. Future developments

DELTA will continue to experiment with wiring apparatus for the net, seeking to enhance, communicate and standardise frameworks and technologies. Additionally, the area of human factors and usability tests of "virtual interfaces for physical machines" and mobile, connected machines will be subject for further study.

See http://www.annecto.dk and http://www.delta.dk

7. References

[1] Web-based Virtual Learning Environments: Experiences and Futures, Morten Wagner, Jørgen Bøegh and Allan Meng Krebs, DELTA Danish Electronics, Lights & Acoustics, Proceedings of WebNet97, 1997.

[2] Using JAVA in developing a CSCW distance education environment, Allan Meng Krebs, Morten Wagner & Jørgen Bøegh, Proceedings of ED-MEDIA & ED-TELECOM 1997.

[3] Experiences with a Web-based Synchronous and Asynchronous Course, Morten Wagner, Jørgen Bøegh, Allan Meng Krebs & Anders Gammelgaard, Proceedings of WebNet96, 1996.

Busy City - On the Design of a Collaborative Learning Environment

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Abstract: This paper describes work in progress to establish a collaborative learning environment in the field of *eBusiness*, i.e. Electronic Commerce and some other fields of modern business informatics. The vision is for a virtual city with a community of citizens that inspires and mediates continuous learning and exchange of experience through hands-on training and field experiments in eBusiness. In this paper we will discuss some facilities and sets of rules for collaboration in this learning environment, which is called *Busy City*.

1. Introduction

Collaboration in *virtual* space necessitates an artificial, time-geographical *context*, such as a virtual classroom with meeting hours, to simulate a more conventional environment for working together. It *is* rather difficult to collaborate if you don't know *with whom, where, when, how* or *why* the collaboration should take place, especially if you don't even have *a sense of place*, or a mental map of your environment. This paper describes work in progress to construct different facilities and sets of rules for collaborative learning in the field of eBusiness based on *The City* as a metaphor for the context in which collaboration takes place.

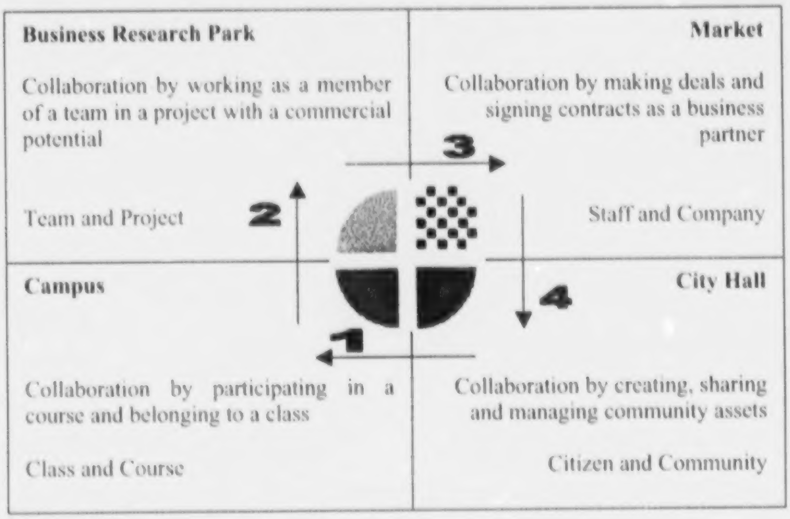
2. Busy City - Learning eBusiness by Creating eBusiness

Busy City is a virtual city in formation, located nowhere and everywhere as a web-site under construction. It will be opened for "immigration" in January 2000 as an integrated learning environment for a set of courses currently running as separate distance courses at Lund University, e.g. General Business Informatics, Electronic Commerce and Business GIS. Busy City is based on a specific concept for distance learning developed by the author: the *Conversity®* concept, which is trademarked. It calls for an advanced learning environment on the Web with *The City* as a basic metaphor and guiding design principle [Wallin 1998]. The installation of Busy City as a Conversity in the field of eBusiness paves the road for a four-tier implementation, including the following facilities and support for collaboration [see Fig. 1]:

- ***Campus***: collaboration in *a class* with virtual classroom facilities such as tools for online class meetings, threaded discussions, online lectures, bulletin boards etc
- ***Business Research Park***: collaboration in *a project* with a project workplace for each team including tools for project administration, task assignments, project timetables, sharing of documents etc
- ***Market***: collaboration in *a virtual company* with support for realistic eBusiness transactions including tools for web-site design, customer registration, payment services, delivery services etc.
- ***City Hall***: collaboration in *a virtual community* with support for large meetings in a virtual conference room and with tools for member administration, voting, zoning and setting of access rights to different facilities and resources in the city, e.g. intellectual property rights etc.

The learning process in Busy City is designed to support and enhance actively a complete *learning cycle* in eBusiness [see Fig. 1], from the novice student to the president of a virtual company who uses eCommerce in his daily transactions with his customers. The student may enrol at the Campus (1) and take a course in eBusiness that has a number of group work assignments. One of these might need the laboratory facilities of a technology provider established at the Business Research Park (2). Here the student may engage in a project to set up a pilot application of a new business idea or a new technology, e.g. an Internet-Shop for virtual travels. The team has the option to transform itself into a management staff of a virtual company that is engaged in real eCommerce business on the virtual Market (3). The running of this virtual company may provide experiences that both the customers and the staff deem are relevant enough to feed back into Busy City as a new establishment, open also for external customers (non-residents). The Community of Busy Citizens at the City Hall (4) must take such a decision as it might influence neighbours etc. The experience gained, the lessons learnt and the future potential of the virtual company, will be taken into consideration in the design of a new course at the Campus (1). In this way, we have a learning cycle that accumulates both theoretical knowledge and practical know-how into a common asset of immaterial, intellectual capital that can be used in new learning processes. During the cycle, Busy City evolves to better serve its purposes as a home for life-long learning in eBusiness.

A dedicated *graduation system* has been developed to integrate this learning process into the primary business process of Busy City to allow more formal careers within Busy City, e.g. a temporary visitor that transforms into a resident Busy Citizen [Wallin 1999]. From a business point of view, Busy City acts as *a factory of new virtual companies* with the Community of Busy Citizens as the first pilot market.



Business Research Park

Collaboration by working as a member of a team in a project with a commercial potential

Team and Project

Market

Collaboration by making deals and signing contracts as a business partner

Staff and Company

Campus

Collaboration by participating in a course and belonging to a class

Class and Course

City Hall

Collaboration by creating, sharing and managing community assets

Citizen and Community

Figure 1: The learning process and the four areas of collaboration in Busy City.

3. Conclusions

To learn eBusiness in Busy City is *to create* and run eBusiness processes - but first experimentally! What makes Busy City unique from other virtual business schools and learning environments is that it goes beyond the traditional "academic" campus concept. It supports and integrates the student's development from being a novice eBusiness student to the launch of a full-scale eCommerce site for a new virtual company. There is no need to leave Busy City to be able to fulfil this development - on the contrary. In a similar situation, a traditional school will have a big loss in time, knowledge and human resources due to the fact that the students have to leave the school to be able to try out their commercial projects somewhere else. Due to the logic of the learning process in Busy City, there is a good chance that both the student and the new virtual company will be fully prepared for successful business operations in the next Millennium.

4. References

[Wallin 1998] Wallin, E. (1998). *Busy City - an overview*. CITY Conversity AB, Lund.
Available as a PowerPoint presentation at http://busycity.ics.lu.se

[Wallin 1999] Wallin, E. (1999). A business model for an online learning community - the case of Busy City.
4th Online Learning Conference euro'99, Gloucestershire Business School, Cheltenham.

Using Online Collaborative Workspaces to Design Technology Integrated Instruction for Supporting K-12 Historical Thinking and Understanding

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Abstract

In this professional development initiative, K-12 California history teachers developed instructional materials collaboratively to support historical thinking and understanding. First, participants examined the use of problem-based learning and technology to support their students' development of historical thinking and understandings in a two-day workshop at UCLA. Then, participants spent the next three months developing instruction in a collaborative online environment that reflected their examination at the workshop. The created instruction will be posted on the Internet.

1. The Project

Beyond Primary Sources: Using Technology in the K-12 History-Social Science Classroom project was conducted jointly by the California History-Social Science Project (CH-SSP) and the Office of Technology Projects in Center X at UCLA. K12 California teacher participants engaged in a guided inquiry to develop instruction focusing on the use of technology and constructivist learning approaches to solve shared instructional problems. Participants examined the use of problem-based learning and technology to support historical thinking and understanding in a two-day workshop at UCLA. In the three-month online follow-up, participants developed instructional materials for their classes reflecting their exploration in the workshop.

Using an online collaborative workspace (Milken Educators Virtual Workspace (MEVW), www.mevw.org), participants synchronously and asynchronously collaborated on their work in progress. Resources such as the State Board of Education Content Standards in History Social Sciences, case studies in history and social science, exercises and theoretical perspectives provided additional guidance. Teachers' questions and concerns about using technology in the history and social science classroom were addressed in the context of exemplary teaching and learning in their content area.

2. The Inquiry Model

Teachers rarely have the opportunity to experience good instruction as learners. As teachers often teach in the same way that they themselves are taught (Fosnot, 89), we believe it is important for professional development to model the teaching that we expect the participants to engage in. In this initiative, teacher participants were both recipients (learning how to develop instruction) and developers (developing the instruction for their students) of the same learning model. The model is composed of three elements: the acquisition of high level thinking skills, the optimal use of technology as an instructional tool and problem based learning as an instructional model.

As recipients, teacher participants engaged in constructivist, problem based inquiry and technology based collaboration to examine their practice. Problem-based inquiry required the teacher participant to identify and solve a "instructional problem" they encountered when teaching historical thinking and understanding. Through collaborative discussion, the participants used technology and problem-based learning to develop instructional solutions to the problem. Participants actively engaged in higher level thinking through continuous reflection on their own design process. They compared their own solutions with those of other participants, providing multiple perspectives and approaches to the problem. These instructional materials require students to engage in higher level thinking (specifically historical thinking and understanding), reflect on their own cognitive processes, solve a problem collaboratively and use technology to support their learning.

3. Historical Thinking and Understanding, Technology and Student Outcomes

Historical thinking and understanding skills essential for students to integrate, recount and analyze various aspects of human aspirations and strivings (State of California State Board of Education, 1999). Students need to be able to think historically in order to demonstrate these deeper understandings. These skills should be integrated into the content standards to produce student outcomes such as explaining, comparing, reconstructing, and analyzing, all of which are higher order thinking skills (Resnick 87). The teacher participants in this project focused on developing instructional materials that encourage student historical thinking and understanding.

This initiative gives teachers an opportunity to use technology to support instruction in a specific way. Exemplary technology integration involves constructivist learning approaches (Jonassen et al. 99). Teachers have many choices in determining how to use technology to encourage historical thinking and understanding. Students might develop their own instructional software or participate in international distance learning projects. By solving an instructional problem with technology and problem-based learning, teachers must think about how to integrate technology effectively. This project required teachers to determine how the use of technology in their instruction will help them attain their instructional goals

4. The Online Collaborative

An additional goal of this project was to explore the use of online collaborative workspaces as a tool both for collaborative work among teachers separated by geographic distance and as a tool for follow up for other professional development institutes. The MEVW space allowed participants to use the Internet to create and participate in collaborative online learning communities. Participants worked in small groups with a facilitator who helped maintain an environment conducive to communication, professional networking and the creation of exemplary instructional materials.

We believe this project illustrates a good professional development model. The problem-based learning model allows teachers to solve historical thinking and understanding problems in students by creating technology-integrated instruction. The combination of both offline and online activities enables teacher participants to establish professional relationships in a familiar and comfortable environment and then extend and utilize these relationships in an online environment. Without this online environment, it is difficult to maintain the relationships established in professional development institutes because of geographical and time constraints. This project explores the use of an online collaboration tool for developing and supporting statewide networking of teachers sustained over time.

5. References

Fosnot, C. T. (1989). *Enquiring teachers, enquiring minds: A constructivist approach for teaching.* New York, NY; Teachers College Press.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning With Technology: A Constructivist Perspective.* NY; Merrill.

Resnick, L. (1987). *Education and learning to think.* Washington, D.C.: National Academy Press.

State of California State Board of Education (1999). *History/Social Science Content Standards Grades K-12.* Sacramento, CA; Author.

Remote Manipulation of A Robot Arm Via The World Wide Web: Recycling Old Technology

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Introduction

This paper describes a series of projects that allow remote users to control a robot arm via the world wide web. Remote manipulation and control of a device is sometimes called teleoperation or telerobotics. The National Aeronautics and Space Administration (NASA) has employed teleoperator devices on the moon. The successful Mars pathfinder mission with the Sojourner rover is an extension of teleoperation where the rover has some "intelligence" on-board which allows it to make some autonomous decisions, but the most critical decisions are made by a human operator on Earth [3].

There are many examples of Internet-controllable robots. These robots allow users to experience a variety of different virtual environments. For example, PumaPaint [2] allows users to create artwork, Carnegie Mellon's Robot Learning Laboratory houses several robots, including Xavier which was one of the earliest autonomous robots controllable via the Web [1], and Telegarden [4], originally developed at The University of Southern California, allows users to participate in gardening.

During the 1997-98 school year, the Department of Computer Science at University of Mississippi was awarded an NSF grant to work with middle school girls. The grant served girls in four remote locations, so activities were needed to encourage the girls to both interact with each other and to use the Web. We decided that if we could have a web site that allowed a girl at one location to play a game with a girl at another location then we would have accomplished both goals. This was the initial motivation behind the project.

Environment of the Robot Arm

Several years ago, we retired a TeachMover Robot Arm (from Microbot, Inc.). We retrieved the robot arm from storage and began the process of making this obsolete piece of hardware the centerpiece of a game that could be played on the Web from remote sites. This particular robot arm was originally distributed to engineering schools to encourage the development of courses in computer-aided design and manufacturing. It is a very simple mechanism that connects to a personal computer through a serial port. Movement of the arm is controlled by instructions given via commands to six stepper motors that control the three joints (shoulder, elbow and wrist), the rotation of the base, and the hand gripper. The motors are controlled by a card in the base that is connected directly to the serial port of the computer. The process of connecting the robot arm to a contemporary personal computer was non-trivial and required extensive web surfing and ultimately email to other users of the Teachmover Robot Arm. The driver code supplied by Brent Juelich and Dr. David Leech at Illinois State University was invaluable. The robot can only connect to the serial port at a baud rate of 9600. Since all commands to the arm are given using ASCII text strings, once the robot was connected successfully, it was easy to use a scripting language to issue commands to it.

Previous Work

This project has been developed in stages. The initial work on the project was undertaken by Mr. Raghu Neelagiri, a Master's student in Computer Science at The University of Mississippi. In order for the robot arm to be used in such a way that the girls could interact with it remotely, three more parts had to be added, a web server, a video camera, and a web page with scripts that allowed a user to control the arm remotely. The web server used was Website by O'Reilly Software, but any web server would work. We chose a rather elaborate video camera (Winnov's Videum Conference Pro) because it came with a card that allowed for onboard compression which we hoped would speed up the video transmission. The scripting language used on the server side was Perl. While any scripting language could be used, Perl has strong text and file manipulation features and can be used to perform server side common gateway interface (CGI) tasks.

The first stage of the project allowed a remote user to perform each of the possible movements of the arm, such as rotate the arm about the base left or right, and move the shoulder up or down, by selecting actions from a web page (form). Each button on the Web page invoked a Perl program, which called a driver program (written in C), which sent the command to the robot arm. The camera was pointed toward the robot arm and captured an image every few seconds. The captured image was refreshed on the web page at a predefined interval, approximately every 10 seconds. A graphic of the command execution sequence can be found at:
http://www.cs.olemiss.edu/webnet/webimages.html.

The second stage of the project was undertaken by Ms. Cindrika Arrington and Ms. Kathy Johnson, UM McNair Scholars in the summer of 1998. Their project involved actually setting up the game of Tic Tac Toe. Tic Tac Toe was selected because of its simplicity and the regularity of its movements. The game board was set up, the pieces were marked and then range of motion measurements were taken so that the game board and the game pieces could be placed within the reach of the arm. Care was taken to allow the arm to pick up all five pieces from each side ("X" and "0") randomly and without allowing any move to interfere with remaining game pieces. Colors of the game board and game pieces had to be chosen to ensure reasonable contrast in the images. Live streaming video software, EmuLive's Server/Producer suite, was added so that the site would have real-time update of the game board. A screen image can be found at: http://www.cs.olemiss.edu/webnet/webimages.html.

The game works well, but there are still improvements to be made. For example, there is no control over remote connections, therefore it is impossible to ensure that players are taking turns correctly. Similarly, the environment is stateless, so it is not possible to know whether one of the players has won the game, or whether moves indicated by the players are valid. One other technical difficulty is the sluggishness of the video.

Work in Progress

Currently, another Master's student is taking the project a step further. His goal is to correct the deficiencies described above by using a Java servlet on the backend, rather than CGI. The servlet can maintain state (so move validation, checking for a winner, a hall of fame, etc, can be included). Use of a servlet will also allow the option of single-user play against the machine controlled robot. The major bottleneck is still expected to be the video streaming software. TrueTech video software is currently being tested but the results are inconclusive at this time.

References

1. Carnegie Mellon Robot Learning Laboratory. http://www.cs.cmu.edu/~rll. (First Edition: 2 April 1998, Last Update 21 November 1998).
2. PumaPaint, http://yugo.mme.wilkes.edu/~villanov/index.html. (Last Update 18 December 1998).
3. Sojourner, NASA Jet Propulsion Laboratory, http://mars.jpl.nasa.gov/rover/sojourner.html. (Last updated 8 July 1997).
4. Telegarden, http://telegarden.aec.at/. (Accessed 22 February 1999).

Global Team Teaching Using the WWW and Internet

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Abstract: We provide first year University students with an International Experience. The International Experience involves learning about a country and its people that are located on the other side of the world. Until recently, the countries had very different political systems. Students form friendships and talk with each other. Finally, they learn to work together on a team and jointly solve a challenging problem. The beauty is that there is no additional cost to the student in travel time or money. Students in the United States (Brooklyn Park, Minnesota) and the Czech Republic (Prague) weekly communicate about personal, societal, and course work topics. They use these tools of the internet and WWW: e-mail, NetMeeting for videoconferencing, chat board, and shared applications. Ultimately, global teams of members from both countries will solve computer-programming problems.

Introduction

In 1993 University teachers from North Hennepin Community College (NHCC), Brooklyn Park, Minnesota and Czech Technical University (CTU), Prague, Czech Republic participated in a teacher exchange with one teacher from each country living and teaching in the other country for a quarter. From this modest beginning grew our Global Cooperation Projects involving team teaching between the countries using the tools of the WWW and Internet. The project pairs computer science classes in both countries for meeting goals in two areas:

1. Promote international cooperation and understanding of diverse groups of people.
1. Promote the ability of students to work in teams, learn how to use correct programming techniques, and get used to the method of cooperation from a distance.

Initially the involvement was with the teachers although students were affected by having a teacher from another country. The teachers involved were galvanized by their exposure to a different culture and educational system. They realized there were substantial misunderstandings about each others' country on both sides. Yet there were also many similarities between the classes. Teachers in both countries had important contributions to make to the education of the computer scientist/engineer of the future. The experience so broadened the teachers' perspectives in the social as well as professional sense that they began to plan for their students to also have this experience. The teachers involved took some of their project philosophy from Vaclav Havel, President of the Czech Republic. In a speech in the United States when he was awarded the Liberty Medal in 1994, he challenged people to think about the world in a new way. He spoke of the necessity for people to see the mystery and poetry of life, not just its technical achievements. As Havel says, our civilization must offer something for the soul and the mind. It is our belief that understanding and respect for another's culture and life style is a noble goal and worth including with our subject matter goals. We decided we had the means to provide a meaningful educational experience for our students that in addition to the desired academic mastery in computer science also offered them 'something for the soul'.

After the teachers returned home from their exchange assignment they began talking with students about the other country and incorporating some of the different teaching techniques they had observed into their classes. The first step of the student involvement began when computer science classes in Minnesota and in Prague were paired. The teachers communicated by e-mail and had their classes do the same assignments. Both classes were aware of the class in the other country. The assignment problems were of a great variety. Some were interesting puzzle problems while others were practical applications. An interesting practical problem appeared one day when a businessman came to see the Minnesota teacher about a problem involving the most economical method of wrapping microwave popcorn. Students and faculty in both countries began a debate and proposed solutions to the problem. The communication was all done by e-mail through the teachers. The solution was not trivial and used advanced mathematics. Three quite different approaches yielded approximately the same results. A summary of these solutions (from students in both countries) and a chart generated from a computer program were presented to the man with the problem. Interest was extremely high in both classes - students and teachers alike were excited to think that they were engaged in solving the same problem as counterparts across the ocean.

Global Cooperation Project

After initial explorations and detailed planning we were ready to begin our first Global Cooperation Project in spring quarter 1998. This was the first trial of forming teams and having students communicate directly with other students using a wide range of WWW and Internet tools. The students involved in the projects were the students of computer science courses. The NHCC students were from the "Algorithms and Data Structures" course. Those from CTU were students from the English language track of the "Introduction to Computer Programming" Course. One motivation for distance cooperation is the fact that so many companies are international in scope with offices in different countries. These companies have an option for employees to travel and then work locally. But this costs both time and money. Fortunately technology is now available that allows for effective cooperation from long distances. Team approaches can be used where the team consists of members working in different parts of the world. We wanted to have the students experience a situation which is close to real life. And in our quickly changing world, teamwork is the only way to be able to come out with new products and be competitive.

For many students the project is the first opportunity to have real working contact with a person from another country. They learn about differences in living styles, they get to know some current events in the other country, and also some personal interests of their team members. This social aspect of the project is mainly accomplished by personal e-mail communication and by using Microsoft NetMeeting and PC cameras for videoconferencing. The official "kick off" of the projects was done by the first videoconference with cameras. Excitement was great as we established contact with the schools. We introduced the teachers who gave an introduction to their respective schools and then the students were briefly introduced. Prior to this students had created their own web home pages and subscribed to e-mail lists that will provide important information about all aspects of the on-going projects.

Students could decide to work on the project proposed by the teacher or they could propose their own projects that were posted on their web pages. Students could create a team by joining somebody who proposed an interesting project or who looked to be an interesting person. Each team had to have members from each country and were two to four individuals. After selecting a project manager the teams analyzed and wrote a detailed specification of the project. They also decided about distribution of the work among the team members. This was followed by analysis and decision making about the data representation and algorithms to be used. Next the algorithms were coded in a programming language (either Pascal or C). Then the students performed detailed testing of the product to prove it was without error. The last part of the project was documentation. The teams documented the projects and wrote a guide on how to use the product and presented this on the project WWW page. The culminating activity was a concluding videoconference between countries involving the entire classes. At this time short oral reports and summary results of the projects were presented.

Conclusions

At the conclusion of the first trial course all teachers were extremely satisfied with the results. We believe it was successful beyond our initial hopes. We discussed the project results with the students. Their conclusion was that even though the work on the global projects was harder compared to a conventional course, they were better motivated and extended their working practice to activities they would not have had a chance to try otherwise. They learned how to use some WWW and Internet tools that should be helpful in their future profession. And all appreciated the social dimension of the collaboration.

References

1. Dubois, Jacques H. (1996). Distance Learning: A Transformation Model for Higher Education. *The MAHE Journal.* Volume 19, October 1996.

2. Farmer, Phillip W. (1997). A Voice for the Developing Countries of the World. *Remarks to 20th Annual Conference on International Education. The Community Colleges for International Development.* February 3, 1997.

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Clash of the Titans: Managing Conflict Online among Adult Distance Learners

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Abstract: Unlike the traditional 18-21 year old college student, the adult learner approaches online distance learning with an existing set of communication styles honed in his/her respective work environment. Those diverse styles may lead to conflict. If not managed properly, conflict can adversely affect the learning experience for all members of the online course. The purpose of this paper is to offer some practical guidelines for managing conflict online among adult distance learners, with special emphasis on conflict prevention

Introduction

Faculty members approaching online teaching for the first time are faced with a variety of pedagogical as well as technology issues. A number of research studies have been conducted regarding instructional design and faculty development for distance education [Moore and Thompson 1990, Kinsey 1990]. When defining the areas of competence required for delivering instruction online, the ability to stimulate collaborative teamwork is almost always cited at the top of the list by researchers. This area of competence becomes particularly challenging when all aspects of the instruction – content delivery, communication, collaborative group work, individual and group assessment – occur in an asynchronous online environment with adult learners. For working adults who may be using electronic communication at work to supplement face-to-face contact, communicating with peers solely through asynchronous discussion groups can be challenging. Unlike the traditional 18-21 year old college student, the adult learner approaches online distance learning with an existing set of communication styles honed in his/her respective work environment.

The Instructor's Role

The role that the instructor chooses to adopt for participation in the discussion is a strong contributing factor to the success of the discussions. Basically, the instructor is expected to provide feedback and to facilitate the continuous flow of information that is useful in shaping the learning process while it is happening [Sherry, 1996]. Instructors who adopt the old "Sage on the Sage" paradigm may contribute to an online discussion characterized by surface thinking, unreflective personal reactions, or examination-style exposition. Conversely, the instructor-facilitator can stimulate adult distance learners into exploration, critical examination of their own thinking, and exploration of the complexities and unresolved issues in the subject area under study.

Preventive Measures

Rude, impulsive behavior, dubbed "flaming", is more common in electronic communication than in any other forum. Comparisons of face-to-face and electronic meetings have shown that group members tend to be argumentative and outspoken in electronic discussions, often leading to increased group conflict [Sproull & Kiesler 1991]. Group conflict may lead to personalization of perceived attacks, alienation of individual learners, and in the worst cases, withdrawal of individual learners from the group and/or course.

The instructor-facilitator must set the tone for communication in online discussions. To reduce the likelihood of conflict, the instructor may take the following preventive measures:

1. Clearly articulate the rules of engagement
2. Ask course members to describe their own style of written communication
3. Discussion room segmentation

Managing Conflict

While adult distance learners usually adhere to the rules of courtesy in online discussions, instructors should be watchful of conflicts that appear to be getting out of hand. Obvious signals are personal attacks on an individual's knowledge or experience, unacceptable language, or unsupported criticism. The instructor can prevent conflict from escalating while still remaining in the role of facilitator/guide. When an online communication displays flame characteristics, the instructor can send a message to the entire group reminding them of the rules of engagement online and re-stating the importance to the learning experience of a positive online environment. This helps to support the individual who was the target of the flame, while stressing to the writer that his/her communication was inconsistent with the code of conduct to which all course members agreed. If the writer again flames a course member, a private note from the instructor should remind the writer of the consequences of non-compliance with the stated rules of behavior. If the writer persists in flaming his/her peers, the instructor should keep copies of the messages as evidence to support punitive measures by the institution. Importantly, the instructor should be careful not to be drawn into a flaming response to the offending writer.

Summary

Fortunately, adult distance learners are usually able to manage conflict in online discussions on their own. Nevertheless, it is essential that the instructor set the stage for a healthy online environment by clearly stating learner and instructor roles and responsibilities and the online code of conduct. Only then can online discussions remain healthy exchanges of opinion among adults rather than a clash of titan egos.

References

[Moore and Thompson 1990]. Moore, M.G. and Thompson, M.M., *The Effects of Distance Learning: A Review of the Literature*. Research Monograph no. 2. University Park: American Center for the Study of Distance Education, Pennsylvania State University, 1990.

[Kinsey 1990]. Kinsey, M.B., "Requirements and Benefits of Effective Interactive Instruction: Learner Control, Self-Regulation and Continuing Motivation," *Educational Technology Research and Development*, 1990, 38 (1), 5-21.

[Sherry 1996]. Sherry, L., "Issues in Distance Education," *International Journal of Distance Education*, 1 (4), 337-365.

[Sproull and Kiesler 1991]. Sproull, L. and Kiesler, S., "Electronic Group Dynamics", *Connections: New Waves of Working in the Network Organization*, MIT Press, 1991, Chapter 4.

[Shea 1994]. Shea, Virginia, *Netiquette*, Albion Books, 1994.

Surviving Your First Web-Based Distance Education Course

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Abstract: To the faculty member whose only teaching experience has been in the classroom, teaching at a distance via the Web seems like a daunting task. The purpose of this paper is to offer some practical tips on surviving the transition from physical to virtual classroom by: a) reviewing some instructional design basics; b) identifying some support and service issues; c) discussing some practical pointers for getting started, and d) looking at some tools to build a personal chest of resources for online instruction.

Introduction

To the faculty member whose only teaching experience has been in the classroom, teaching at a distance via the Web seems like a daunting task. On the one hand, the idea generates images of reading assignments and planning lessons in one's pajamas, free from the limitations imposed by classroom equipment, building ventilation, snarling traffic and the 50-minute lesson period. On the other hand, the task of stimulating students to explore the concepts and practical applications of your discipline solely by means of what you can fit on a 17 inch VGA monitor – 15 inches on some laptops – seems an impossible dream. Do you have the funding and resources of a small Hollywood production studio to convert your course content into a flashy multimedia show? Not very likely. The purpose of this paper is to offer some practical tips on surviving the transition from physical to virtual classroom.

Fleshing Out the Issues

Delivering all of your course content via the Web requires consciously stepping yourself through the basics of instructional design, summarized nicely in The Communicators Handbook [Maupin House 1996]: namely, goal statement; defining the learner; developing learner objectives; designing the evaluation; developing the content; selecting the instructional method and strategy, and ; selecting the delivery method

Once you've decided on your instructional design and formulated your strategy, a stream of issues that were "no-brainers" now become question marks. For instance, in addition to technical support, what about training students on how to navigate through the online course materials? Who is responsible for getting my materials onto the Web, for adding/modifying course content once its online? If I have to prepare my own materials, who's going to teach me how to use the authoring software? Online learners expect to have the same library, text and lab materials and resources as the classroom-based learner. How does the institution meet those expectations

Getting Started

Most faculty members already have some digitized materials: PowerPoint presentation slides, text prepared using some word processing software, access to free graphics, clipart and photos via the web. The very first step should be to take stock of the materials you've already accumulated over the years. The availability of high-quality, low cost scanners has allowed institutions with modest resources to acquire one or more of these units. Materials that may not yet be in digital form – articles, printed graphics and photos – may be scanned in for inclusion in your courseware package. Ideally, you would like to have a means of organizing your materials so that you can create content relatively easily, and re-cycle those materials for other courses you teach in the future.

Authoring Tools

Creating course materials is the most time consuming, resource-intensive portion of faculty workflow and there are a variety of shrink-wrap products for authoring. However, nearly all of the PC-based authoring programs require a fairly robust technology skill set to get beyond on-line page turning. Distance education course management systems such as CourseInfo, WebCT and Learning Space address web-based course administration and communication and have authoring tools that are relatively easy to use. However, they are not nearly as rich in functionality as the PC-based authoring tools.

Does ease of use always mean sacrificing authoring flexibility and functionality? A good authoring tool should provide step-by-step creation methods, templates, sample Web pages that can be adapted for individual use, automatic generation of CGI scripts, and basic instruction for creating standard components [Hansen and Frick 1997]. But the authoring tool should also be flexible enough to provide the functionality and the benefits of multimedia tools and integrate seamlessly into whichever course management system the institution has selected. MICROCOSM [HREF2] is an authoring tool that meets all three requirements: ease of use, rich in functionality, seamless integration. Created by a university consortium in the United Kingdom and winner of several international awards, MICROCOSM allows faculty to gather and organize multimedia materials to create courseware for on-line delivery without having to learn programming. Task cards and wizards in plain English step the faculty through the creation of the course, with lots of positive reinforcement along the way. Once the course is created, it can simply be "dropped" into the institution's course management system via a Publish-&-Go wizard. Course content can be published to CD-ROM for large-scale local data storage for static and archived information, to save bandwidth for interactive components on the Web. Microcosm helps the faculty member build a chest of learning resources that is adaptable for various instruction delivery vehicles.

Summary

The key to becoming comfortable with web-based distance education is to experiment. Most software vendors will provide limited-time free copies of their authoring tools for faculty to try, so you can find the one that works for you with no financial risk. To be a novice is not an insult. Given the age of the Web, most faculty are just that. You can share ideas and experiences with fellow "newbies" and with the early adopters by joining listservs like ITFORUM, hosted by the University of Georgia, or WWWDEV, hosted by the University of New Brunswick. Importantly, your students are excellent resources, particularly when Web-research becomes part of the course work. After those first steps, you'll thrive, not just survive.

References

[Maupin 1996]. *The Communicator's Handbook*, Maupin House, Gainesville, 1996.

[HREF1] MHEC Interactive Courseware Initiative Framework Home Page
URL: http://www.umn.edu/mhec/ici/framework.html

[Hansen and Frick 1997] Hansen, L. & Frick, T.W. (1997). Evaluation Guidelines for Web-Based Course Authoring Systems. *Web-Based Instruction*. Englewood Cliffs, NJ: Educational Technology Publications Inc.

[HREF2] MICROCOSM PRO Home Page
URL: http://www.multicosm.com/microcosm/index.html

Using E-Designed Courses to Enhance Teaching and Learning

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Abstract: California Lutheran University's Teaching, Technology, and Teamwork (TTT) faculty development program uses a team-based approach to help faculty members integrate technology into the curriculum. In creating and re-designing courses and course modules, teams build on and reinforce successful pedagogical practices and the one-on-one student interaction that is so valued by the University. Faculty from a range of disciplines are targeted in the TTT program.

Recognizing the importance of integrating technology into the University's teaching and learning environment, CLU faculty approved a set of revised criteria for hiring, promotion, tenure, and review that incorporates the use of technology as a key element in a faculty member's repertoire. CLU's administration has also made a significant commitment to integrating technology into the curriculum.

A major challenge now confronting CLU and other higher education institutions is how to support faculty members in improving their technology skills and applying those skills to their instructional methods on a routine basis (Candiotti and Clark 1998). At present, only 10% of CLU faculty employ at least five of the eight commonly used technologies: e-mail, newsgroups, web, chat, PowerPoint, video, teleconferencing, and 3D manipulation. Our early adopters are, to some degree, integrating these tools with the seven principles for good practice in undergraduate education: student-faculty contact, cooperation among students, active learning, prompt feedback, time on task, high expectations, and respect for diverse talents and ways of learning (Chickering and Gamson, 1987; Chickering and Ehrmann, 1996). Time and resource restraints have, however, made it difficult for faculty to add technology to their teaching.

According to the research (Shapiro and Cartwright 1998) and our own experience, creating quality instructional modules requires a team approach. We implemented our Teaching, Technology and Teamwork (TTT) project to incorporate these findings, and have subsequently found that working with colleagues in a university-supported Center for Teaching and Technology is an effective method for engaging faculty in course re-design.

Building on Successful Pedagogies One of the major goals of CLU's Strategic Plan *(CLU 2001)* has been to enhance the personalized, one-on-one teaching and learning approach so valued by the University. This approach, the first of the "Seven Good Practices" identified by Chickering and Gamson, has been favored by faculty who have worked in CLU's low teacher-student ratio classrooms. Many of the faculty have developed other successful and unique pedagogical strategies as well.

E-Design Process & Procedures CLU's TTT project teams e-design courses or develop course modules by combining good practices (Chickering and Gamson 1987; Chickering and Ehrmann, 1996) and the eight commonly used technologies. The cardinal attraction of our program and one that will affect the quality of the projects is that it can be customized for each faculty member. Each project will adhere to the following objectives: increase student achievement levels; enable faculty to use the tools of technology to support "good practices" and CLU's central value of one-on-one faculty-student instruction; effect a significant increase in the number of faculty members combining technology and pedagogy to improve their teaching; and provide a mechanism for the ongoing renewal and redesign of instruction at CLU and beyond.

The TTT Program is designed to provide the resources and support necessary for its success, including the CLUnet infrastructure and the University's Center for Teaching and Technology. Faculty are given the time needed to develop or re-design their courses and/or explore and incorporate new pedagogical methodologies into their teaching. Faculty submit proposals for specific projects to the Information Technology Advisory Committee (ITAC), who evaluate the proposals.

Faculty whose proposals are selected receive a stipend for the semester during which they work on the project. The instructional team supporting the work of each selected faculty member brings together the skill set appropriate to the proposed project. The purpose for using the team approach is to bring sufficient resources to the curriculum design process for the achievement of a quality product of high distinction (Kimber and McKay 1996; Horgan 1998; Peed-Neal 1998). Each of these team members will bring essential expertise to the course design and implementation process.

Faculty Member	Content expertise: subject matter and discipline, concept, and instructional plan
Librarian	Information literacy and resources expertise
Instructional Specialist	Expertise in project development; appropriate pedagogical and technological solutions
Student Intern	Responsible for technical expertise and for making a contribution based on personal knowledge and perspective
Evaluator	Assessment expertise: current teaching, student performance and student feedback

Table 1: Team Members and Their Roles

In conducting an on-going and comprehensive evaluation, the project teams draw from the tools and lessons learned in the body of research from the Flashlight Project (http://www.tltgroup.org/programs/flashlight.html). Since the proposed project relies on the seven principles of good instruction, using the survey items included in The Flashlight Project's Current Student Inventory (Ehrmann 1998) helps ensure that we are using validated items and that we will contribute to the ongoing collection of data on pedagogical change and outcomes using appropriate integration of technology.

Summary Richard Kimball, president of the Teagle Foundation, proposed in a letter to the editor of *The Chronicle of Higher Education* (11/19/97) that "Instead of viewing technology as a threat or a corrupting force, professors should regard it as offering extraordinary opportunities to make a difference in students' lives--and in their own." CLU supports this goal in its Strategic Plan and has made noteworthy progress in achieving it. Receiving the 1996 CAUSE Award for Excellence in Campus Networking marked a milestone in that effort. The Teaching, Technology, and Teamwork plan has the potential for making a major difference in the lives of those involved in both teaching and learning at CLU and beyond. Now fully launched, this program is to be incorporated into the University's long-term plan for faculty development.

References

Candiotti, A., & Clarke, N. (1998). Combining Universal Access with Faculty Development and Academic Facilities, *Association for Computing Machinery* (January) 36-41.

Chickering, A., & Gamson, Z. (1987). Seven Principles of Good Practice in Undergraduate Education," *AAHE Bulletin* (March).

Chickering, A., & Ehrmann, S.C., (1996). Implementing the Seven Principles: Technology as Lever, *AAHE Bulletin* (October) 3-6.

Ehrmann, S. C., (1998). The Flashlight Project: Tools for Monitoring the Progress of our Hopes and Fears about Technology in Education, *The Technology Source* (July).

Horgan, B., (1998), Faculty, Instruction, and Information Technology, *The Technology Source* (August).

Kimball, R., Letter to the editor of *The Chronicle of Higher Education* (11/19/97).

Kimber, D., & McKay, J., (1996), Action Research into the Quality of Student Learning: A Paradigm for Faculty Development, *The Journal of Higher Education* (September/October).

Peed-Neal, I., (1998), Teaching Centers, Instructional Technology, and Course Development, *The Technology Source* (September).

Shapiro, W.L., & Cartwright, G.P., (1998), New Ways to Link Technology and Faculty Development, *Change*, (Sept/Oct) 50-52.

Teaching Technology through Tradition: Native Access to Engineering at Concordia University

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Abstract: The Native Access to Engineering Program addresses issues related to the under-representation of Aboriginal people within the science and engineering sectors in Canada. Because its target audience is widespread and largely remote, the program benefits from the Canadian government's commitment to national connectedness by distributing materials and developing initiatives via the World Wide Web (WWW).

Introduction

In 1993, the Faculty of Engineering and Computer Science at Concordia University entered into an agreement with l'Ordre des ingénieurs du Québec to develop concrete strategies to increase the representation of Aboriginal people within the engineering profession. Over six-years, the Native Access to Engineering program has evolved from a small operation aimed at Aboriginal high school students within the province of Quebec to a broad-audience, national project supported by the federal government, Aboriginal organizations, big business, academia, and the Canadian research establishment.

Concordia's Native Access to Engineering Program is unique in Canada. It is the only institution to address the long-term challenge of increasing the representation of Aboriginal people in science and technology sectors of the Canadian labour market. The focus is on the development and strengthening of technical skills, knowledge and expertise within the context of Native community needs and cultural identity.

Within Canada, delivery of national programs is complicated by challenges of geography and population distribution. The country measures 4634 km from north to south and 5,514 km from east to west. While the majority of the population lives in the south within 200 km of the US/Canadian border, there is still a significant percentage living in rural and remote communities. Aboriginal people constitute a majority of this rural/remote population. Communications technologies have historically played a significant role in addressing the challenges of geography and population. As such, Canada has been quick to embrace the Information Highway in all of its incarnations. In fact, several Canadian initiatives (SchoolNet and the Community Access Program to name a few) are international exemplars of connecting people and communities for life long learning.

This paper provides a brief background to the conjuncture of the Native Access to Engineering Program and Aboriginal issues in Canada, and examines the important role of WWW in taking the project to a national audience.

Native Peoples in Canada

According to the Department of Indian Affairs and Northern Development (DIAND), the current Aboriginal population is 1,333,700 people, or 4.4% of the Canadian population [DIAND November 1997]. It is a population growing at an unprecedented rate: the on-reserve birth rate is more than double that of the Canadian population as a whole. The 1991 Census/Aboriginal Peoples Survey conducted by Statistics Canada found that about 54% of Registered Indians living on reserves are under 25 years of age. In some communities, this percentage rises to in excess of 50% under the age of 18. There is clear evidence that the explosion in birth rates is ongoing and consistent across all regions of Canada [Ibid.]. So, unlike the general Canadian population which is dominated by the concerns of aging baby boomers, many concerns within Aboriginal communities focus on youth and the young, education and training.

Additionally, there is an ongoing and evolving change in the relationship between Aboriginal peoples and the Canadian and provincial governments. Described in *Time* as "One of the boldest social-justice experiments in the country's history" [Purvis 1998], the goal is to "give native [sic] peoples land, money and political power." [Ibid.] This major shift in national policy is largely in response to the recommendations contained within the *Final Report of the Royal Commission on Aboriginal Peoples* a 5-year, multi-million dollar investigation into the strained relationship between the Government of Canada and its First Nations inhabitants. RCAP recommends fundamental changes in the relationship at all levels; the ultimate goal being the development - over a 20-year period - of self-government (within the confines of Canadian Confederation) for Aboriginal Nations.

Self-government, education, leadership and infrastructure

Despite Canada's consistently impressive showings in United Nations rankings, if the "on-reserve aboriginal population were viewed as a separate country ... it would fall somewhere below Mexico and Thailand and be on par with Brazil." [Ibid.] The fact is that many Aboriginal communities are essentially "developing;" there are large disparities between the on-reserve population and the larger Canadian population in terms of income, employment rates, infant mortality, suicide rates, basic infrastructure etc. [Ibid.]. Furthermore, the significant infrastructural, engineering and technical needs of Aboriginal communities are still primarily addressed by non-Native people. There are just not enough Aboriginal engineers and scientists to go around. This lack of trained community people means that huge sums of money leave Aboriginal communities and do not contribute to local economic development, thereby exacerbating existing conditions and maintaining "dependency" conditions.

For self-government to become a reality education is key. In 1979, less than 100 Aboriginal people were enrolled in post-secondary institutions across Canada [Munro 1979]. That number grew exponentially to 27,000 in 1994-95 [DIAND 1997]. While the trend is very encouraging, the reality is that in 1991 only 2.6% of the Aboriginal population over the age of 15 held university degrees (compared with 11.6% of the non-Aboriginal population) [RCAP 1996]. In addition, there is still tremendous dropout rate at the secondary level; the 1991 census indicated that less than half of Aboriginal people were completing high school [Ibid.]. The long-term goal of self-government requires that the pool of young Aboriginal people with the skills to fill leadership positions in all sectors must grow dramatically within the short- and medium-terms.

The Native Access to Engineering Program, First Nations SchoolNet and the WWW

The Native Access to Engineering Program was initially established to promote the engineering profession to Aboriginal high school students in Quebec. It began as a series of summer camps where Native students were invited into the university for a week to learn about engineering and its connection to their communities and traditions. Unfortunately, there was no follow-up support in community after the students returned home. The next step was to provide concrete support for teachers in schools so that they could connect engineering to the existing curriculum in a culturally relevant manner. This lead to the ongoing development of a series of newsletters, worksheets and teacher's guides, which were - at first - distributed only in hard copy. As the project has evolved, it has become more and more focused on distance learning; connecting students, teachers and leaders from different and widespread First Nations communities together through information about science, engineering, tradition, leadership, sustainable community development and how they interact.

The costs associated with producing, printing and distributing curriculum materials are substantial; to extend the program across Canada, to 631 reserves (plus a number of urban schools) would be prohibitive without the use of a network like the WWW. Luckily, the Canadian Government has made a serious commitment to national connectedness, and particularly for connectedness of Aboriginal schools and communities. Through the First

Nations SchoolNet program run by Industry Canada, every Aboriginal school under federal jurisdiction will be connected to the Internet. The program is run in partnership with telecommunications companies in the Stentor Alliance. These companies absorb the cost of providing high speed Internet access to First Nations schools through Telesat's DirecPC satellite services [Industry Canada Summer '98]. Schools receive satellite terminals, computers, funding and technical support from SchoolNet; as of the fall of 1998 the project was 80% complete [Industry Canada Fall '98]. So, the network for distribution of the Native Access to Engineering Program's material exists.

The Native Access to Engineering web site (http://www.nativeaccess.com) allows teachers, students, parents and community leaders to access all of the program's materials in an on-line interactive format or to download it for classroom use in PDF format. It also provides teachers, who are generally young, non-Native and posted to isolated communities with few resources, with access to culturally relevant math and science teaching tools. Perhaps even more importantly, the WWW allows for the delivery of material in a highly visual format which matches the learning style of Aboriginal students. In the future, the site will be expanded to include interactive features where students on reserve can talk with engineering students at Concordia, connect with mentors, get online tutoring and consult advisors for education and career counseling.

Conclusion

Aboriginal communities in Canada have not generally been successful in producing large numbers of graduates. Thus far, delivery of education that has focused on western world views has proven inadequate. It is hoped that the combination of curriculum materials which incorporate and celebrate Native culture and wisdom with the interactivity and visual interface of the WWW will offer students a new way to look at the world, and a new way to see themselves which might encourage their exploration of and curiosity about math, science and engineering.

References

Department of Indian Affairs and Northern Development (November 1997). *Demographics* (Background paper). Ottawa: Government of Canada.

Department of Indian Affairs and Northern Development, Information Service (1997). *Indian and Inuit Students enrolled in Post-Secondary Studies*. Ottawa: Government of Canada.

Industry Canada, First Nations SchoolNet (Summer 1998). *The Learner's Circle*. Ottawa: Government of Canada.

Industry Canada, First Nations SchoolNet (Fall 1998). *The Learner's Circle*. Ottawa: Government of Canada.

Munro, John (1979). Department of Indian Affairs and Northern Development, Information Services. *Indian Conditions*. Ottawa: Government of Canada.

Purvis, Andrew (1998). Whose home and native land? *Time*, February 15, 1999, 16-23.

Royal Commission on Aboriginal Peoples (RCAP) (1996). *Gathering Strength*, Volume 3. Ottawa: Government of Canada.

Incorporating Web-Based and Virtual Reality Instruction into a Distance Education Course Using the ADDIE Model of Instructional Design

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Abstract: The use of virtual reality (VR) applications in web-based distance education is still in its infancy. Instructors and instructional designers do not have specific models, let alone many case studies, upon which to design and implement web-based distance instruction using VR applications. Therefore, the purpose of this paper is to describe a case in which the well-known ADDIE model of instructional design was used to create the instruction for a one-hour web-based seminar using a VR application.

1. Introduction

Virtual reality (VR) is the ability to immerse the computer user, as an active participant as opposed to a passive viewer, in a computer-generated experience [Grimsdale 95]. The use of VR applications in web-based distance education is still in its infancy. Instructors and instructional designers do not have specific models, let alone many case studies, upon which to design and implement web-based distance instruction using VR applications. Therefore, the purpose of this paper is to describe a case in which the well-known ADDIE model of instructional design was used to create the instruction for a one-hour web-based seminar using a VR application.

2. Background

The virtual seminar was part of an advanced undergraduate communications course on computer-mediated communication (CMC) that was taught at a distance at a medium-sized American university during the fall of 1998. The VR application chosen for this seminar was The Palace, a web-based chat, client/server program that lets both the instructor and learners, who are represented by a creative avatar, go from room to room inside virtual worlds to chat, problem solve, collaborate, share, play, learn, explore, experience, and talk with other learners around the world. To design and develop the seminar instruction, the ADDIE model was used.

3. The ADDIE Model

ADDIE (Analysis, Design, Development, Implementation, and Evaluation) is an acronym for the basic phases one can follow in creating instruction [Rossett 87]. In the Analysis phase, one searches for and defines the problem and determines whether instruction is the appropriate intervention. If instruction can solve the problem, then information about the learners is sought and used in the Design phase in which the overall goal and specific learning objectives are created based on the desired learning outcomes, and the instructional strategies and delivery medium or media are selected. Once the instruction has been designed, the actual instructional product(s) (i.e., print materials, web pages, computer programs, etc.) are produced in the Development phase. The instruction is then tested during the Implementation phase. Finally, the success of the instruction is determined during the Evaluation phase.

4. Using the ADDIE Model in VR Distance Instruction

4.1 Analysis

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During the Analysis phase, designers gathered information on the course goal and objectives, the types of CMC applications to be taught and used in the course, and the required course readings and assignments. Information about the learners was gleaned from an online student background survey, student homepages, and correspondence with the course instructor. Information about the learning environment, especially the technologies and Internet connection speeds particular to each student as well as to the campus computer labs to which students have access to, was provided by the instructor.

4.2 Design

Based upon the information gathered in the Analysis phase, the goal and learning objectives for the virtual seminar were decided upon and the instructional media were selected. The goal was to gain knowledge and skills on The Palace in order to comment upon its application in a learning environment. The Palace was selected as the instructional medium based upon such factors as availability of and access to the medium, cost of the medium, the amount of knowledge and skill required to operate in and communicate with the medium, the development time and complexity of programming needed to create the learning environment for the medium, and the availability of and access to the technologies needed to access the medium. The instructional products for the seminar were also decided upon, and specific instructional strategies, such as the use of role-playing in The Palace learning environment, the use and varying types of pre-seminar instruction, and the use of questions both during and after the seminar, were incorporated into the design of the instructional products.

4.3 Development

Besides the actual production of the instructional products during the Development phase, which included a lesson plan for the seminar, pre-seminar web-based instruction, pre-seminar email instruction, pre-seminar in-class, hands-on instruction, and The Palace learning environment itself, the use of VR required that the developer create the virtual tools, such as avatars and props, that the student would use during the seminar.

4.4 Implementation

While the virtual seminar was the core of the instruction, the implementation of instruction actually began with an in-class, hands-on orientation to The Palace, followed by further instruction delivered via the web and email. Once the pre-seminar instruction was implemented, the virtual Palace seminar took place for one hour with three groups, each consisting of three to five students.

4.5 Evaluation

As this is a work in-progress, the authors are still in the process of conducting both formative and summative evaluations of the distance instruction in order to refine the instruction and determine whether the goal of the instruction was achieved.

5. Conclusion

Positive post-seminar comments from the seminar participants, course instructor, moderators, and instructional designers seem to indicate that the ADDIE model can be a good general system to follow when trying to incorporate web-based and VR instruction into a distance education course.

6. References

[Grimsdale 95] Grimsdale, C. (1995). Virtual Reality Systems. Cambridge, MA: Addison-Wesley Publishing Company.
[Rossett 87] Rossett, A. (1987). Training needs assessment. Englewood Cliffs, NJ: Educational Technology Publications.

Work-in-Progress Short Papers

Web Architectures for Database Access

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Abstract: Starting from may 1998 the "Istituto per lo Sviluppo della Formazione Professionale dei Lavoratori" (ISFOL), at the request of the Italian Ministry of the Environment, begins to render accessible via Web the results of a nation-wide census on the teaching and training activities pertaining to environmental themes carried out at Italian universities, secondary schools and professional training centres. The paper documents in brief the technical solutions adopted in implementing that part of the Web accessible information system relative to querying the database via the WWW. The system has been realised using currently available Java technologies such as applets and servlets interfaced to the database system through the JDBC. The paper also introduce the evolution of the system.

Introduction

The rapid growth of the Internet in recent years has brought about a considerable increase in the structural and organisational complexity of the data accessible and distributed via the Web, thus engendering a huge enriching of the information available. Great impetus towards a *global* information system came mainly through two factors: the integration of Web data with database management systems (DBMS) and the development of *"intelligent browsers"*, enabling local execution of *mobile code*. Nowadays, the combined exploitation of these two characteristics is ever more frequent in high information-content Web sites. The chance to test out the technologies for Web access to DBMS in actual use was afforded in the framework of the project *"Development and distribution of an information system on environmental training"* [Aloia et al. 98].

The ANFORA Information System

The project's ultimate aim was to render more accessible the results of a nation-wide census on the teaching and training activities pertaining to environmental themes. From the computer-science perspective, the goal we established for ourselves was to set up a system which would be independent of the specific hardware or software characteristics. The architecture opted for was a three-tiered system. The interfaces for formulating data searches are made up of a number of Java applets that enable users to specify suitable filters in a friendly way. Interaction with the DBMS takes place on the server by means of servlets., which builds the queries and executes them through the JDBC driver [Hamilton et al. 98], then passes the results over to the Web Server, which formats and transmits them to the client. In order to improve server-side performance, we adopted a solution that consists of activating a pool of connections, each of which is managed by a single thread (connection broker). Because of the 'persistent' nature of the servlets, the connections will be shared by subsequent DBMS invocations. The system performed well in several tests using different DBMS, as well as different JDBC drivers, with no source code modifications whatever.

Next Step: INFEA an Open Hypermedia System

A new phase of the project, supported by the Italian Environment Ministry, is in progress and is named INFEA. The aim is the development of an Open Hypermedia System in which the users become actors in the management of the information related to environmental issues. The needs for co-operative work and distance learning are important requirements of the new system. Our main goal is the implementation of a Web Based Information System that integrates the DBMS technology with new tools available on the Web, such as those for the Computer Supported Co-operative Work (CSCW). The architecture of the system we adopt is multi-tier. Thin client realised by means of Java applets, and/or XML, communicates with the application server using CORBA and/or Java RMI [Orfali et al. 98]. The application server implements the business logic using the Enterprise Java Beans technology and manage the interaction with the DBMS..

Bibliography

N. Aloia, D. Canino, C. Concordia (1998). *Un sistema informativo sulla formazione Ambientale* Consiglio Nazionale delle Ricerche, Internal Report

Graham Hamilton, R. G. G. Cattell, Maydene Fisher (1998). *JDBC Database Access with Java A Tutorial and Annotated Reference* Addison Wesley.

Robert Orfali, Dan Harkey (1998). *Client/Server Programming with Java and CORBA* Wiley Computer Publishing

WebQP : Web-based Teaching Assistant Quizzes Provider

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Abstract : This paper reports a kind of web-based CAI server system called WebQP that has a database storing teaching materials for quizzes written by teachers or editors via www in support of WebQP and, when accessed from students or learners, sends them pages containing quizzes constructed from the database, making them learn by means of answering the quizzes and reading explanations sent after answered. For each learner and for each quiz, the learner's answer is recorded and used for selecting quizzes hereafter to be sent. WebQP has now three question types of quizzes: word-mean, multiple-choice, and matching. After teaching, WebQP serves to make students review and soon to know how much they learned.

1. Introduction

We have been developing a kind of web-based CAI server system that gives students or learners various types of quizzes related to contents of teaching courses. We call it WebQP and have used it on trial in a class for teaching C/C++ programming. This paper describes the WebQP, which is now working on our web-site.

Since 1997, we have tried to develop various applications as the university intranet information systems supporting education and researches, working on our web-site managed by IIS(Internet Information Server) on a Windows NT server and using a database Microsoft Access. They are systems for searching books, for seeking employment and for distributed data-input and automatic publishing of home pages with unified specification such as teaching staff information, syllabuses and so on. On the same web-site environment, WebQP has now been developing and working. They are shown (almost in Japanese) at

http://anzlabo.elec.kyukyo-u.ac.jp/

2. Outline

This system WebQP is given as two sets of ASP files, HTML page files, image files and so on. One of the sets is for authoring and the other for learning. Namely, the former, *the authoring management part*, makes teachers or editors input teaching materials into the web database through intranet/internet from their web browsers on their machines. This part has a table called *Editor Table* used for managing editors or teachers registered. And the latter, *the learning management part*, makes students or learners learn by solving quizzes written in pages which are generated from the web-database and sent to web-browsers on their machines. And this part has also a table called *Learner Table* used for managing students or learners registered.

In the database, we have now three kinds of teaching material tables that each record in the tables has two fields such as a word or a term and its mean (*Type 1: Term dictionary*), a problem and solution candidates of which only one is correct (*Type 2 : Quiz dictionary with solution candidates*), or a problem and all correct answers (*Type 3 : Quiz dictionary with solutions*). From the record, a quiz page is generated and sent to learners. And furthermore, each record has a field containing a detailed explanation sent to the learners after answered, fields of evaluations obtained by analyzing answers of the learners, and fields describing information used to determine the timing of making a quiz to be sent.

These tables (i.e. dictionaries) are all managed in a table called *Dictionary Table*.

3. Quiz Tables And Quiz Pages

According to the above three types of tables, the following types of quiz pages are derived.

Quiz pages derived from the type 1 table are used for making users learn terminology in various fields. Each page contains a sentence, some terms and such a question which term has the sentence as its mean. The sentence that means a term has to be carefully described not so as to use the term itself. Of course, the detailed explanation sent after answered can fully use the term if necessary.

Each quiz page derived from the type 2 table contains a problem and its solution candidates which are all only copied directly from a record in the table. When one of the solution candidates is clicked, it is sent to WebQP as its answer.

Each quiz page derived from the type 3 table contains a problem and a text area where the answer has to be typed. And then the answer is sent to WebQP where it is compared with each one of the solutions.

4. WebQP Serves For Authoring And Learning

After a person is registered by the authoring management part as one of teaching material editors, the person is able to make the system create a table, insert records into the table and update the records from a web-browser on their machine. When creating a table, the editor has to attach a title to the table representing a branch concerned with contents that the editor wants to write in the table and to select the type out of the above mentioned three. The editor can make the system open or close the table to be used by the learning management part.

When accessed from a learner, the learning management part of our system makes the learner select one of the titles of tables related to such the branch that the learner needs or wants to learn. Then the system generates a page containing a quiz constructed by the system from the table according to the above-mentioned characteristic and sends it to the learner. When the learner sends back an answer to the system, the system at once returns a page that makes the learner know whether it is correct or not and describes the detailed explanation related to the quiz.

The order of getting quizzes out of a dictionay in the database is from the first to the last. However, it is locally randomized. Therefore, it is able to make orders of quiz sequences sending to client machines different each other but obtaining globally the property of the sequence from the basic to the higher. Furthermore, for each learner and for each quiz, the results of the answers are recorded and used for selecting the successive quizzes and for evaluating their achievement and the quiz itself.

As an option, a user can call out a Microsoft Agent which speaks various messages according to each stage of the learning process.

5. Remarks

Each ASP is written in JavaScript for client side scripting and in VBScript for server side scripting. In a page, places used for debugging is written in VBScript as client side scripting in order to find there easily.

Microsoft Access used as the web-database in WebQP is now working well. The speed of LAN may protect from over-accesses to it. The quiz tables (i.e. dictionaries) are independent each other and managed only in the Dictionary Table. Therefore it is easy that any one of the tables move into the other WebQP working on the other web-site.

After teaching a class, we have made students in the class review the lesson by using this system. In process of successively applying quizzes given by the system, we expected the students to effectively learn by carefully reading the explanation sent after answered. As result, we had been very pleased to find the students working earnestly with WebQP in spite of enriching the contents of the lessons.

Toward a Taxonomy of Risks to Human Subjects involved in Internet-based Research

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Abstract: The practical application of research ethics must continually evolve to remain relevant as more research involves computer-mediated communication (CMC) and Internet-based research. There is a broad scope of harms to which subjects of research may be at risk. Physical harm, psychological abuse, loss of privacy, and unwanted public exposure are common research concerns that take on an added edge in research involving CMC. The permeability of the Net; the persistence of electronic data; and the electronic identification inherent in CMC all pose unique and far-reaching risks to subjects. The authors present a taxonomy of risks to human subjects organized by research intervention.

In June 1999 the AAAS (American Association for the Advancement of Science) and the OPRR (Office for Protection From Research Risks) sponsored an exploratory workshop on "Ethical and Legal Aspects of Human Subjects Research in Cyberspace" in Washington DC. The intent of this gathering was to reflect on ethical concerns emerging as research using the Internet and studies of the Internet and cybercommunities become common. As part of that workshop the authors presented a talk on the risks and benefits of research on the Internet. Building on this work the authors present a taxonomy of risks of Internet research organized by the type of research intervention.

There is a broad scope of harms to which subjects of research may be at risk. The extreme of that harm would be physical injury and death. More common concerns include psychological abuse, loss of privacy, and unwanted public exposure. Additional concerns include damage to interpersonal relationships, legal jeopardy, and threats to one's livelihood or career. Computer-mediated communications intensifies the historically identified risks of research articulated in both biomedical and social science literature. All of the above risks, including death, may come about as a consequence of public exposure or an undesired sharing of the information provided to researchers by, and about, subjects. The severity of this breach is, of course, dependent on a number of variables, such as the sensitivity of the information gathered, the vulnerability of the subjects, and to whom the information becomes available. Each of the above potential harms is made more likely, however, for subjects involved in research using the Internet because three features of computer-mediated communications (CMC) can contribute to just such a public exposure.

First, we discuss the risks inherent in the *permeability* of Net communications and suggest precautions that can be taken to minimize that risk. Second, we discuss the risks that accompany the *persistence* of electronic data, including storage mediums, and issues involving collecting such data into databases. Third, we review the potential risks of *electronic identification* inherent in computer-mediated communications. We discuss cases in which these risks have manifested in the harm of subjects.

There are many non-obvious implications of computer-mediated communication and several ways researchers can and should protect the subjects of their research. These questions are of interest to researchers, policy makers, commercial providers and the whole range of Internet users because given the permeability of the web, all users may be unwitting subjects of research and other forms of invasive data collection.

Establishment and Management of the Padua Astronomical Observatory Web Site www.pd.astro.it

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Abstract: The Web Site of the Astronomical Observatory of Padua (Italy) has been one of the first sites of WWW in 1994. The increase in the volume of information and resources available on the Web for Astronomers required a complete revision of the Site organization and a new full time position for a person in charge of this project.

A new site capable of presenting the Observatory to the outside world and at the same time capable of supplying useful services for its employees has been created. Steps towards the realization of the new Web Site, problems encountered, adapted solutions and lessons learned are here described and discussed.

In 1994 the Astronomical Observatory of Padua created one of the first Web sites.

It is important to note that some of the pioneers of the Net are to be found within astronomical Institutes. The reasons being that the category of Astronomers consists of few people spread all over the World, and their work largely consists in elaborating large amounts of data (images) and in transmitting the results to other collegues in a collaborative environment. In 5 years the site has provided different services that have been mainly aimed at researchers. The explosion of the World Wide Web has been fundamental to its growth: infact astrophysical information, both the quantity and type of data available on Internet has grown incredibly [Andernach H. (1998)].

Nowadays, the typical work cycle of an astronomer is almost all done on the Web.

The increase in the volume of information and resources available on the Web meant that the first site's organization had to be reviewed. Therefore, the Observatory decided to appoint a person who would be in charge of managing the Site.

My work as Webmaster began in March 1998. The results of a first careful analysis made it clear that the site had to be designed from "scratch", nothing could be gained by gathering more information and putting the existing material in order. There were 5 stages to the re-organization: *Planning, Revision, Establishing the prototype, Feedback from a chosen sample group of users* and *Publishing*. After publishing the 6th stage, *management*, is still in progress now. Planning and revision required the most work and time.

Planning

It was evident right from the beginning that the main problem was one connected to the *organization*, therefore, it was necessary to get right into the Observatory's work organization system.

Three principal aims were established during this stage:

1. The new site would have to have a *double use*: a) to offer important services for the benefit of the Observatory's personnel, both researchers and administrative staff (Intranet), b) to provide services for its external users, for example Astronomers of other Institutes, people interested in Astronomy, etc... It would have to act as an interface between the Observatory and the World outside.

Achieving this aim was made possible by choosing the right kind of *contents* that would be made available on the Net [Siegel D. (1997)].

2. The site would have to be organized so that it could be *visited by as many people as possible*, therefore, delivering quick and specific services. To reach this second aim the contents had to be *organized* in an efficient and effective manner, as well as having an appropriate graphic design.

3. The site would have to be organized in such a way to allow the Webmaster *constant supervision and updating* of both the contents and technology. Before this could be done precise rules had to be defined regarding who would supply the contents, which methods would be used, and what would be the limits of the Webmaster's responsibility. The latter regarded *choosing the kind of behaviour* to adopt in all the phases of the fine tuning of the new site.

Revision

The revision phase consisted in presenting the project to the Director of the Observatory, to people that supervise the project, and to several researchers who had been actively involved in realizing the first site. For 7 months the project was continually reviewed, revised and replanned, each time a more complete and correct project was proposed until eventually a scheme was defined and the prototype of the Web application could be developed.

Establishing the prototype

It took 6 months to realize the prototype, at the beginning this 3rd stage overlapped the planning and revision stages. The main tool used to manage and realize the application of the Web was MS Front Page '98.

Feedback

A sample group of users from the Observatory was chosen. Their different suggestions, ideas, problems they had encountered were all gathered and listened to and, the modifications were made accordingly.

Publishing

After the feedback stage the Site was published and the first one was then substituted.

Management

After the Site was published, it could be said that it was not only the start of the management stage but also the beginning a new phase of feedback, which would provide useful information valuable for improving the Site. This was made possible by the flexible structure that had been chosen for its organization, more will be said about this in the description of the Site further on.

The actual management stage consists mainly in keeping the contents updated, in order to do this efficiently it is necessary to be fully involved in the organization of the work of a public Institute. It is essential to know who to ask for information regarding work and the people to address to about making certain information public or not.

Description of the Site

The new site was structured and organized in the following way in order to reach the three aims mentioned above:

1. The *contents* were chosen so that the Site would have a "double" use:

i) There is a section that is for Observatory employees only, which gives them the possibility to fill in administrative forms on-line. There are also other sections which are of interest not only for internal Observatory staff but also for external users, too.

ii) There is a section dedicated to scientific Research carried out at our Institute. This is of utmost importance for the external position of the Observatory, as unfortunately not all researchers present their work on the Web. This particular section was created with the aim of stimulating them to transfer their research and results on to the Web.

In the Web server of the Astronomical Observatory there is also an *education and outreach Web site of Astronomy* which is introduced during this conference in a Poster/Demostration intitled. *"Catch the stars in the Net" an Astronomy educational and outreach project via the Web.*

2. *The organization of the contents* and the *specific techniques* of the site were planned in a logical structure so that the users can get exactly and quickly what they need without feeling frustrated by unnecessary complex operations. With this aim in mind we decided to choose a hierarchical structure.

Such a solution represents one of the best ways of organizing information for such a type of Web site [Lynch & Horton, 1999]. The site is, therefore, organized around a Home Page that acts as a point of entry into all the other pages. The information available through the Home Page is divided into 3 different levels of complexity and depth.

As well as having organized the contents according to the above-mentioned structure 2 other choices were made: a technological crossbrowser and simple graphics. The graphics were designed to create a visual hierarchy, which would accentuate the most important elements.

3. During the planning stage *the Webmaster's role was defined*. Once agreed that the principal task was to organize the contents present on the Web site, it was then decided who would supply them. It was also decided that all the documents regarding bureaucratic-administrative matters would be visioned by the Director of the Observatory before being made public.

The main information of the research section is supplied by the researchers, who have complete responsibility for the contents reported in it. In this case the service provided by the Webmaster concerns the final step of it being presented on the Net or the creation of specific links.

In *conclusion*, after a complete restructuration, I can say now that the new Site satisfy the users. This can be argued by the increased number of entries and by the positive feedback. The future development plans for the Site are the implementation of the Intranet side that will concern the administrative application forms that will become totally automatic. This, however, will be possible when there are specific laws regarding digital signatures. Future plans for Internet are mainly concerned with developing the Research section so that all the scientific results carried out at our Observatory are presented on the Web.

References

Andernach H. (1998). Internet Services for Professional Astronomy *astro-ph/9807167 v3*

Lynch, P., & Horton, S. (1999). *Web Style Guide: Basic Design Principles for Creating Web Sites.* Yale University Press info.med.yale.edu/caim/manual/contents.html

Siegel D. (1997). *Secret of Successful Web Sites.* Hayden Books www.secretsites.com

Information Retrieval on the WWW: A Method Adapted to Trainers' Features in Distance Education

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Abstract: The WWW represents a privileged environment when trainers want to extract information in order to product hypermedia courses for Distance Education (DE). This paper presents research work in progress that aims to conceptualise an information retrieval method in this educational context. It is advisable to design trainers' features, to clarify how these features define trainers' needs and to study how this need expression is used in the information retrieval process.

1. Introduction

The huge documentary multimedia and educational data available on the WWW is increasingly used by Distance Education (DE) trainers in order to design hypermedia courses. The structure and navigation of educational materials must be planned in accordance with pedagogical goals and learners' features (knowledge, experience, skills and above all, isolation). Thus, information retrievals, which are done in order to exploit WWW data in this DE context, are fixed by criteria related to course conception, and they are bound by trainers' knowledge and skills.

However, the diversity of Web data and the escalating number of users, lead information search tools (such as Altavista,...) to implement a maximal standardised service. These tools are not adjusted to the trainers' features and trainers' needs and trainers have many problems in the interrogation step and results analysis step. Trainers must visit one site after the other because they can't target their information extraction and results are not necessarily relevant to pedagogical course goals.

This inability to adapt often discourages trainers causing them to abandon Web information exploitation [Wilkinson, 1999]. So, an interesting research problematic arises to study the possibilities to adjust information retrievals to suit trainers developing hypermedia courses for DE. This paper presents research work in progress that aims to conceptualise an information retrieval method in an educational context. This method seeks to give to trainers assistance at need expression step, results extraction step and results analysis step. The next paragraph describes the different points of view of this problematic.

2. A method of information retrieval dedicated to trainers properties

It seems essential to identify educational context particulars through trainers' specificities. For conceptualising trainers' features, we employ user model concept like Eklund and Zeiliger in [Eklund, Zeiliger, 1996]. Thus, the study of a trainers group and trainers' activity enable us to build the *trainer model* to define their main stereotypes. We assumed that in DE context, trainers' stereotype are related to educational materials, conception strategies, learning strategies and learners' features.

A fundamental first step is to define how information need is expressed according to Web sites or Web pages and to specify the relevance concept. Thus, we consider a site as an entity with a set of features, such as textual content, extern hypertext links, intern hypertext links and ergonomics point of view, ... So, a relevant Web site can be defined as an entity with a subset of these features each equal to a particular value. As result, defining a trainer's need is equivalent to identifying these features and assigning them a value. A set of reference criteria, called the *reference model*, must be designed according to trainers' features and DE context particularities.

Then, equivalence between all stereotypes intrinsic to the *trainer model* and all criteria pertaining to the *reference model* must be achieved. It is necessary to study how the pedagogical goals, trainers' knowledge and preferences determine document textual content, document organisation and document ergonomics. Moreover, it is indispensable to analyse what conditions related to Web sites features are implied by authoring course process. We realised a first empirical study with a trainer member of the DESS SIM (a post graduate diploma which provides an eight hundred hours specialised course in multimedia). It is a distant course and it will be reported in September 1999 at the University of Picardie and presented by Leclet, in [Leclet, 1999]. Realisations and perspectives of this study are described below.

Finally, comparison between the *reference model* and the Web site must be determined. Firstly a protocol allowing comparisons of Web sites features with criteria of the *reference model* must be designed. Then, the result of this comparison defines the *relevance indicator* that is presented to the trainers and estimates the correlation between Web sites and trainers' needs. However, a comparison between the *reference model* and the all Web sites is difficulty feasible. Consequently, it seems appropriate to use existing search engines, such as Altavista, and compare the *reference model* only with a subset of Web sites, which are extracted by "classic" keyword queries.

Experimental information retrievals were performed in order to build a Human Computer Interaction course, integrated to the DESS SIMAD. An information retrieval process, which can be composed in three steps, had permitted to valid results by trainers. The first concerns the production of a set of keyword queries for a same search session, according to the *reference model*. The second consists of setting these results in a corpus, which is filtered two times successively. The first filter level removes redundant and not valid links. The second eliminates Web sites that do not carry the features determined by the trainer. At this level, a filter is equivalent to the definition, for a feature F, of an only and necessary value V or a set of values V_i ($1 \leq i \leq n$, n is the number of values). All Web sites with the feature F not equal to V or to one of the set of values V_i are eliminated. Finally, the third step of the information retrieval process is composed by the relevance estimation of the results according to the trainers' expressed needs. Firstly, this estimation is made informally with the trainers' collaboration and would be developed when the experimental corpus gets bigger.

3. Conclusion and perspectives

This experimentation underlines that the trainers' need expression step and the results validation step must be formalised. We propose now a new experimental protocol with a group of DESS SIMAD trainers design hypermedia courses. Several steps make up this protocol. The first corresponds to an interview with each trainer in order to define their need and to identify their preferences, the pedagogical goals, the learning strategy and the characteristics of authoring process. The second aims to synthesise the interviews in order to design a questionnaire and consequently build the *reference model*. The third consists of perform customised information retrievals, according to the information retrieval process described above and the responses to the questionnaire. Results estimation and validation gather the last one. The results are submitted to the trainers together with a satisfaction rating. Questionnaire responses will allow us to verify the original hypothesis stated about the *trainer model* and the *reference model*, to upgrade those models and to achieve a first validation of our method.

Later, the method will be partially automated in order to achieve an information retrieval supporting tool adapted to trainers' features in DE context. The conception of this tool would be described in future communications.

4. References

[Eklund, Zeiliger, 1996] – Eklund J., Zeiliger R. (1996). Navigating the Web : Possibilities and Practicalities for Adaptive Navigational Support, *AusWeb 96*, Gold Coast , Australia.

[Leclet, 1999] – Leclet D (1999). New Technology In Information And Communication : A French Experience, accepted paper to *WebNet 99*, Association for the Advancement of Computing in Education, Hawaii, USA.

[Wilkinson, 1999] – Wilkinson R (1999). User Modeling for Information Retrieval on the Web, *Second Workshop on Adaptative Systems and User Modeling on the WWW 1999*, 8th International Word Wide Web Conference, Toronto, Canada.

The Journal of High Energy Physics: Scientific Publishing on the Web

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Abstract: The Journal of High Energy Physics (JHEP) is a scientific journal written, run, and distributed by electronic means, the entire editorial work is carried out by means of a software. JHEP encompasses all areas of High Energy Physics, and is produced by ISAS (International School for Advanced Studies, Trieste-Italy) INFN (Italian Institute of Nuclear Physics, Italy), the CERN (European Laboratory for Particle Physics) and IOPP (Institute of Physics Publishing, UK), with the support of the scientific community. Born in July 1997, JHEP is now established as one of the leading journals in the field.

The Journal

The Journal of High Energy Physics (JHEP) is a scientific journal written, run and distributed by electronic means. In running such a journal the objective is to capitalize on the innovative advantages of the new media: rapidity of communication, broad diffusion and low costs.

First published in July 1997, JHEP was a natural outgrowth of the extensive use of electronic means by the community of physicists. Particularly remarkable are the electronic preprint archives (http://xxx.lanl.gov/) of the Los Alamos National Laboratory that have so successfully replaced the conventional system. JHEP is now an established publication and one of the leading journals in the field of High Energy Physics. At present it is produced and funded by ISAS (International School for Advanced Studies, Trieste-Italy), INFN (Italian Institute of Nuclear Physics, Italy), the CERN (European Laboratory for Particle Physics), and IOPP (Institute of Physics Publishing, UK), with the support of the scientific community. It is a truly not for profit enterprise, and the access to the journal is completely free of charge for all interested users.

The quality of the journal is guaranteed by the Advisory and Editorial Boards, composed by the most distinguished scientists in the field. Furthermore, JHEP has maintained the system of peer review, that constitutes the most remarkable difference between scientific journals and the online archives of papers [Boyce 1999, Harnad 1999 and references therein, Smith 1999]. Paper and CD-ROM versions of the electronic archive are published and distributed by the Institute of Physics Publishing (IOPP, UK).

Market Impact

Scientific communication has become instantaneous, with authors creating their personal library on their computers, thereby avoiding thousands of unnecessary pages. Retrieval and printing with book quality is possible at very low costs. At the same time, most libraries have been squeezed financially and archival space problems have become critical. As a consequence, over the past fifteen years most libraries have gone through the painful process of cutting subscriptions. The US Association of Research Libraries calculates that its 114 member libraries spent 142% more on journals in 1997 than 10 years before, but ordered 6% fewer titles. In the same year Reed-Elsevier, the publisher of 1200 scientific journals, reported profits of 378 million US$ on sales of 938 million US$ in its scientific activities [Butler 1999]. Commercial publishers and learned societies have introduced electronic versions of their journals. However, they have linked their use to subscribing to paper versions or are reintroducing page charges (for a list of Physics online journals see http://PhysicsWeb.org/).

JHEP has proved to be an efficient and cheap alternative to conventional publishing that nevertheless maintains essential publishing features: scientific and editorial quality control, easy retrieval, and archival responsibility for the future. The costs of running such a journal can be easily supported by the scientific community, and funds thus saved that can be earmarked for other scientific purposes. JHEP could therefore be the right answer to the need for a new path for scientific communication. Although it is now produced for the High Energy Physics community, it could be considered as a model for developing other scientific journals in a number of disciplines.

How JHEP Works

The online publication of papers is made possible by the complete automation of the editorial work, that is carried out by means of a software robot, thereby reducing costs and speeding up the procedure. The software takes care of all stages of the editorial procedure: submission of papers, assignment of the papers to the appropriate editors, review by referees, communication between editors, referees and the Executive Office, revision, proof-reading and publication of papers, as well as the administration of the journal. Accepted papers are made available on the JHEP websites to all interested readers.

The JHEP software robot consists of three major families of programs. The first allows the interaction between JHEP and the scientific community, which is the section where papers are published and submitted by the authors. The second family runs the interface among editors, between editors and referees, and between editors and authors. The third family is in charge of the administration of the journal.

To assure reliability and fast connections, JHEP is a network of nodes. Currently active sites are:

http://jhep.sissa.it http://jhep.cern.ch http://jhep.mse.jhu.edu http://jhep.weizmann.ac.il

http://jhep.jinr.ru http://jhep.yukawa.kyoto-u.ac.jp http://jhep.tifr.res.in http://jhep.ift.unesp.br

All nodes are equivalent and kept synchronized. All events taking place at any of the nodes are immediately notified to the other nodes. On notification, the nodes execute the corresponding action and update themselves accordingly. All transactions are encrypted to protect the data.

Special multimedia facilities have been added to enhance the possibilities offered by the Web:

- Powerful search engines replace the table of contents and indexes used by paper journals
- Papers, which published in three different formats (PDF, PS, DVI), are hypertexts, with links within the article and to the papers quoted in the references
- The possibility for readers to post comments and ask questions to the authors of the published papers is currently being developed
- The possibility of using JAVA to view papers directly with a browser is currently being developed.

References

Boyce P. B. (1999). *Electronic scholarly journals*, http://cdsweb.u-strasbg.fr/misc/epub-talk/1.html

Butler D. (1999). The writing is on the web for science journals in print, *Nature*, vol. 397, p.195-200

Harnad S. (1999). *For Whom the Gate Tolls?*, http://www.cogsci.soton.ac.uk/~harnad/amlet.html

Smith A. (1999). *The journal as an overlay on preprint databases*, http://ridge.aps.org/APSMITH/ALPSP/talk.html

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Mechanisms for Video Integration and Navigation on the Web

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Abstract: This paper discusses the main issues and presents mechanisms for video integration and navigation on the Web.

There is an increasing interest in the use of video in hypermedia, and in particular on the Web. The motivation isn't new, but technological advances are making it more feasible, by reducing the limitations in cost, distribution and display. To provide video on the Web is a flexible way to publish and access video information. It simplifies the distribution process, and provides the user with the possibility to access it anywhere, anytime and at his own pace. Furthermore, in an hypermedia environment, video can be integrated with other information and tools in a seamless way, opening new dimensions not present in either medium by itself. In spite of its potential, video has been integrated in hypermedia, and the Web in particular, in a rather poor way. Until recently, when supported, video could only be manipulated in a way similar to a VCR, and links could only be made to or from video as a whole. True integration of video in hypermedia requires a more powerful model, defining the semantic of linking to other videos or other media, and an adequate navigation support.

To achieve video integration in hypermedia, there is a need for video hyperlinking support. In [Chambel 99], we define a model and tools for hypervideo on the Web. Besides from the basic linking mechanism in space and time, there are significant challenges to the navigation support, when this dynamic medium is involved. Link awareness is one such challenge: how link anchors should be represented in order to be perceived by the user? It is a particularly relevant issue, considering that: links may have duration; several links can coexist in time and space; and video changes in time, requiring a more permanent attention from the user. More information has to be provided, in a way that is not too distracting to the user, but helps in navigation. We identified five types of link awareness relevant in hypervideo: Where From: where is the link anchor or hot spot?; Where To: what is the destination of the link?; When: when do we have link opportunities?; When To: what is the destination sub-video?; For How Long: for how long will the links remain active? In that paper, we go into more detail in this respect and give some examples.

Being a dynamic medium, video content changes over time while presented. As such, the information space where it is integrated can also change somehow, reflecting new relations with it. An example of this is the integration of the video with some external information that acts as its index, referring to different portions of the video. This information can act as a map to the video, providing information about its content and assistance to its navigation, as orientation and direct access. For this purpose, we define a video index as a sequence of entries, relating time positions in the video with the information chosen to represent that part of the video. Indexes can be represented by text, images or video. For each entry, there are two states: *on* and *off*. An entry is *on*, while the cursor is over it, or when the video is playing on the time interval to which the entry corresponds. This is true, even when the current position on the video changes, in response to direct access through video controls, or after a follow link into the video. Entries are also defined as links to the corresponding moments on the video.

On and *off* states can be represented in different ways, depending on the type of the entry. For image entries, two different images are used. These typically correspond to different versions of the same image, with different highlights. Figure 2 (figures available at http://www.di.fc.ul.pt/~tc/webnet99_figures) exemplifies a video index where the index entries are images: the first frame of the video at the corresponding time. *On* state is represented by the flat frame image. *Off* state is represented by another version of the same image: embossed, shadowed and a little smaller. In this example, going from *off* to *on* state has a visual effect similar to a button click, also making the image clear and easily spotted, for orientation purposes. For text entries, *on* and *off* states can be represented by changes in text properties: color, font, size, style, etc., in isolation or combined. Figure 1 exemplifies a text index, where the status is differentiated by color (*on*: white, *off*: dark blue). Video entries can be small segments of the video, from the beginning of the video segment they are representing. *On* and *off* states can correspond to play and stop or pause video states. In this case, when the cursor is moved over an index entry, a small preview of the destination video is played.

A visual summary of the video can be constructed as a video index, based on the images that correspond to scene changes, and can be constructed with the aid of video processing techniques [Correia 96]. Using the visibility property for images *on/off* state, slide presentations can be synchronized with a video. More than one index can be associated with the same video. In this way, it is possible to have more than one type of additional information associated and synchronized with the video. For example, an index representing the video table of contents, and another one showing the exercises relevant to the video topic being presented.

Indexes can also have the functionality of a play list. For this, index entries have a selected state and an order. Playing this kind of index has the effect of playing, in the specified order, the video segments corresponding to the selected index entries. The entries state and order can be changed interactively, and can be defined with an initial value by the page author. If defined invisible, a play list will just influence the way the video is played, with no interference from the user. The play list functionality is inspired in the audio and video editing equipment, and also extends to video the hypermedia concepts of path and guided tour. It is of particular interest in an environment where consumers are also authors, and the access to and reuse of information is very common. In this way, users can assemble video segments to make personalized versions of their favorite movies; and a teacher can make available portions of a video, in a particular order, to illustrate concepts in a context where the original video wouldn't be so efficient or concise. Note that these can act as views to information available elsewhere.

These mechanisms are implemented as extensions to HTML. New elements and attributes were defined and their functionality is supported by a set of scripts that are generic, reusable, and almost transparent to the author of the hyperdocument. The authoring process is done in a declarative way in "extended" HTML. The current prototype is based on Dynamic HTML and uses VBScript language and ActiveMovie technology.

Approaches to the integration of video with other media in different environments include [LiestØl 94, Sawhney 96]. SMIL [W3C 98] addresses the integration of video, as a synchronizable media type, on the Web. Video can participate in links, and it can be synchrozided with other media elements. It provides for the basic hypervideo and synchronization mechanisms, but does not explore richer solutions for navigation support, and is not supported by common browsers. HTML+TIME [HTML+Time 98] builds upon the SMIL recommendation to extend its concepts into HTML and web browsers, but it is still a proposition. A less general approach was made for Sync-o-matic 3000 [Sync-url], a product that integrates Powerpoint and RealVideo/RealAudio to make on-line lectures. It synchronizes the slides being presented with the video of the corresponding lecture. There are similar applications that use MS NetShow/WindowsMedia technology [Media-url] instead. Markers are defined for the video and associated with the URL to be presented at each of those moments. Links to those markers can also be defined.

The mechanisms and tools presented are being tested and validated in the context of a project [Chambel 98] on interactive multimedia for open and distance learning, where video plays a central role, but was traditionally used in isolation from other materials. In the future, we will extend these and explore new ways to support video integration and navigation in hypermedia environments, with the goal of making our interaction with information and knowledge more efficient, flexible and rich.

References

[Chambel 98] Chambel,T.,Almeida, J.B.de,and Guimarães,N., (1998) *Multimedia Artifacts That Help Us Learn Perspectives of the UNIBASE Project on Distance Learning*. Workshop on Multimedia and Educational Practice, ACM Multimedia'98, Bristol, UK.

[Chambel 99] Chambel,T., Correia,N., and Guimarães,N. (1999) *Towards Hypervideo on the Web*. IMSA'99, Third IASTED International Conference on Internet and Multimedia Systems and Applications, Nassau, Grand Bahamas, October 1999.

[Correia 96] Correia, N. and Guimarães, N. (1996) *Components for Video Processing Applications*. 4th Eurographics Workshop on Multimedia, Multimedia on the Net, Rostock, Germany, May 1996.

[HTML+Time 98] *Timed Interactive Multimedia Extensions for HTML (HTML+TIME) Extending SMIL into the Web Browser*, Submission to W3C, September 1998. http://www.w3.org/TR/NOTE-HTMLplusTIME

[LiestØl 94] LiestØl,G. (1994) *Aesthetic and Rhetorical Aspects of Linking Video in Hypermedia*. In Proceedings of ACM Conference on Hypertext'94. Edinburgh, UK. 217-223.

[Media-url] MS WindowsMedia, http://www.microsoft.com/windows/mediaplayer/

[Sawhney 96] Sawhney,N, Balcom,D., Smith,I. (1996) *HyperCafe: Narrative and Aesthetic Properties of Hipervideo*. In Proceedings of ACM Conference on Hypertext'96. Bethesda, MD. 1-10.

[Sync-url] *Sync-O-Matic 3000*, http://www.egr.msu.edu/~crs/projects/syncomat/

[W3C 98] W3C (1998), *Synchronized Multimedia Integration Language (SMIL) 1.0 Specification*. W3C Recommendation, 15 June 1998. http://www.w3.org/TR/REC-smil

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Learning in the Information Age

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Abstract: Through the integration of WWW (World Wide Web) in learning various subject areas, the typical classroom is no longer bound by four walls; it is open to include students, experts, and learning experiences from the world. WWW is changing the way students learn. However, information resources available through WWW is overwhelming and sometimes, difficult for some individuals to explore. Integrating information literacy into curriculum or problem-solving tasks is important for promoting active learning and the development of critical thinking skills among various learners.

1. Learning and WWW

Technology can be used as a vehicle to change the roles of both students and teachers in the classroom. Recently years, World Wide Web (WWW) has been widely used with various subject areas. With this vehicle, teachers can learn how to incorporate technology into their everyday teaching styles in a meaningful manner, whereas students can manage the problem individually and cooperated with their peers (Halpin & Kossegi, 1996). As the Web-based learning has been integrated in various subject areas, how to help students to develop broad skill experience and encourage motivation for learning become an important issue (Barron & Ivers, 1998). In a school-reform effort all over the world, school libraries have changed in focus from collections to learning. Academic libraries have pivotal roles in creating a culture in the school that is learner-centered (Stripling, 1996). Along with the progress of technology, adapting knowledge and experiences from learning theories is essential to encourage active and self-directed learning, and to achieve a life-long learning purpose.

In teaching, the WWW promotes the delivery of computer-aided instruction (CAI) for various instructions. Integrating the WWW in instruction involves finding and retrieving resources on the Web, communicating, publishing, and developing teaching and learning activities using the Web. Many cases indicate that the WWW is an ideal tool for providing different levels of distant education. Relating Web resources with learning contents and developing instructional activities on the Web has become an effective learning model for encouraging active participating in learning.

The ideal WWW learning environment combines electronic and human resources to create autonomous, lifelong learners. Instruction provided through WWW should incorporate active learning model to facilitate students to take an active role in their learning. The use of technology has great impact on schools and libraries. As stated by Weinberger (1997, p624) "Students need to experience the joys of free-form learning and self-guided discovery rather than being tethered by the constraints of outdated tomes, overcrowded classroom, and information overload".

Information skills are needed for problem solving, and that related information skills should be developed within the context of real need and the overall information problem-solving process. Research and practice suggest that people learn better when learning information literacy is related to their needs. Students will eagerly participate in learning and internalize the information skills if they realize how these skills relate to their school assignments and the problem-solving tasks (Warmkessel & McCade, 1997).

2. Active Learning

As constructivist-cognitive movement thrives in recent education reform, the emphasis of learning are changed from a teacher-center to learner-center. In this transition, students become active learners. Instead of passively receiving information from classroom, students are invited to explore the world of knowledge. Learning occurs when students are actively involved in the learning process. To learn actively is important in every educational environment, especially for WWW. Learning means understanding. It means that learners have been confronted with new idea and have changed and reconstructed their previous understanding to incorporate those new ideas.

The power of digital libraries and new media technologies can provide the passion of learning, and a reward for seeking (Weinberger, 1997). In the new age of learning, students enjoy themselves in a context rich with resources and strategy-building activities to assist them in developing their skills as researchers or explorers in specific knowledge area.

3. Problem Solving and Information Literacy

In order to integrate scaffold learning, students need opportunities to engage in autonomous learning strategies, such as linking ideas, comparing alternatives, reflecting on progress, or critiquing ideas with support and guidance. In the Information Age, how to help students develop information skills to explore the world of knowledge becomes an important issue. Schools and libraries should take a more active role in creating a learner-centered environment that allows sharing of resources and communication of ideas to facilitate the active construction of knowledge among learners.

The library literature emphasizes the use of information, and defines information literacy as the ability to recognize an information need and to locate, understand, evaluate and use the needed information. The information literacy is important to help people successfully solve problems and make decisions. Research and practice suggest that people learn better when learning information literacy is related to their needs. Students will eagerly participate in learning and internalize the information skills if they realize how these skills relate to their school assignments and the problem-solving tasks (Warmkessel & McCade, 1997). If information literacy is integrated into problem solving activities in the earliest stages of students' educational careers, it will provide potential impact on students' life-long learning, and skills of thinking and evaluating. Students will be also encouraged to be self-directive and to work collaboratively with others.

4. Implications for Instruction

In the WWW learning, the skills used for problem solving and relating and evaluating information become important. Information literacy among learners is the key to their life-long learning. The skills are needed for problem solving in the real world. Since information literacy stresses the universal skills such as developing good research strategies, applying critical thinking in approaching information is important. By promoting the process of interactive and expressive nature of learning through WWW, the social construction of knowledge is held. More meaningful learning will be fostered.

Rather than restructuring the instructional program predominantly to the learning of a fixed body of knowledge, it is important to improve the use of instructional methods that encourage the utilization of information resources. To promote thinking skills and active learning, placing the student in the center of the teaching/learning process to reflect the use of information in the real world in solving every-day problems is essential. Since information literacy is critical in solving problems, creating an instructional environment that encourages the use of information skills in the problem scenarios should be an effective way to reflect active learning and thinking.

5. References

Barron, A. E. & Ivers, K. S. (1998). *The Internet and instruction, 2nd Ed.* Englewood, CO: Libraries Unlimited, Inc.

Halpin, P. & Kossegi, J. D. (1996). *The WWW, preservice teachers and their mathematics courses.* ERIC Document: ED405819.

Stripling, B. K. (1996). Quality in school library media program: Focus on learning. *Library Trends*, 44(3), 633-637.

Warmkessel, M. M. & McCade, J. M. (1997). Integrating information literacy into the curriculum. *Research Strategies*, 15(2), 80-88.

Weinberger, M. I. (1997). Just in time learning with electronic library. *Library Trends*, 45(4), 623-638.

MedExpert/WWW: A Medical Knowledge Base Server

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Abstract: Since summer 1998 a medical knowledge base server is available at URL *http://medexpert.imc.akh-wien.ac.at* considering the importance of decision support systems in health care based on Internet technology. The available systems on this server are (1) HEPAXPERT-III/WWW, an expert system that interprets the results of qualitative and quantitative routine serologic tests for infection with hepatitis A and B, (2) ToxoNet, a knowledge-based system intended to provide automated decision support to the clinician about a possible affection of a pregnant woman with toxoplasmosis and, thus, a probable threat for the unborn, (3) JAWS-ABC, a system that supports classification for early diagnosis, diagnosis and progress evaluation of craniomandibular malfunction, and (4) LARSEN, a system for computer-assisted scoring of radiographic abnormalities in rheumatoid arthritis. This paper presents a summary about these systems.

Background

Knowledge-based decision support systems will become more and more important in health care. Based on Internet technology such systems perfectly match the requirements (such as access from every computer, ease of use, ...) to work in clinical infrastructures for the next century.

Objective

Since summer 1998 a medical knowledge base server is available at URL *http://medexpert.imc.akh-wien.ac.at* in the World Wide Web. Users of this server have the possibility to access several knowledge-based systems for decision support in medicine.

The following systems - developed at our section - are in operation at present:

(1) HEPAXPERT-III/WWW is an expert system that interprets the results of qualitative and quantitative routine serologic tests for infection with hepatitis A and B. The fully interactive system based on *Cold Fusion Application Server* is the successor of an off-line HEPAXPERT/WWW [Chizzali-Bonfadin et al. 1997] that returned the results by e-mail up to 24 hours after request. The system automatically provides and interprets the result of the laboratory tests measuring antigens and antibodies, without the use of additional biochemical or clinical data, and thus helps physicians to understand complex serologic findings. To deal with all possible combinations of findings, the knowledge base of HEPAXPERT-III/WWW contains 16 rules for hepatitis A and 131 rules for hepatitis B interpretation. In analyzing serologic test results, the program compares the constellation of serologic

findings with constellations that may occur in the course of hepatitis A or B infection. Possible active or passive immunization is taken into account as well. However, there are several possible sources of misinterpretation, such as deviations in the course of the disease from the assumed courses, as well as falsely positive and falsely negative findings. Therefore, in each case the program's conclusions have to be correlated with the patient's overall clinical picture. Serologic test results can be entered and will be interpreted immediately. The reports that HEPAXPERT-III/WWW automatically generates include (a) the entered results of the tests, and (b) a detailed analysis of the results, including virus exposure, immunity, stage of illness, prognosis, infectiousness, and vaccination recommendation. It is possible to interpret incomplete and uncertain results as well as prototypical results. Furthermore, as a check on the laboratory results, any inconsistent combinations of findings are identified.

(2) ToxoNet is a knowledge-based system intended to provide automated decision support to the clinician about a possible affection of a pregnant woman with toxoplasmosis and, thus, a probable threat for the unborn. The results are derived from analyzing the outcome of SFT (Sabin-Feldman dye test) and IgM ISAGA (Immunosorbent agglutination assay) tests performed in terms of the obligatory serological screening program of pregnant women in Austria. ToxoNet is accessible from within a World Wide Web browser located on any computer equipped with a connection to the Internet. Apart from the possibility to investigate a patient's state resulting in an interpretation consisting of a diagnosis and a therapy recommendation, the system also enables the physician to modify the inference mechanism by adjusting the underlying knowledge base to new needs.

(3) JAWS-ABC is a system that supports classification for early diagnosis, diagnosis and progress evaluation of craniomandibular malfunction. The ABC staging rate (= subjective complaints; temporal suffering) contains the specification as a result of patient history and palpation. After classification of the patient into a specific state (A, B, C, or no designation), an analysis table is used to get the diagnosis and a view of the stage of illness. The progress of a malfunction is determined by the JAWS-grading (= objective complaints).

(4) LARSEN is a system for computer-assisted scoring of radiographic abnormalities in rheumatoid arthritis. Evaluating radiographs of rheumatoid arthritis by scoring systems is internationally established. An accurate quantification of erosive diseases gives an appropriate assessment of the disease status at a given time, serial measurement of radiographic damage provides a view of the disease course and the essential data for calculating a progression rate. We have developed a computer program that allows a fast, accurate, and reliable documentation of erosive and degenerative changes on radiographs of hands, wrists, and feet in rheumatoid arthritis. The program is able to calculate the score (currently we are using the Larsen Score but the software is able to support other scoring systems as well) and to deliver diagnostic hints based on the pattern and types of morphologic changes.

Technical Specification

MedExpert/WWW is based on *Microsoft Internet Information Server*. The operating system of the Dual-Pentium-II personal computer is *Microsoft Windows NT*. The web server is extended by *Allaire Cold Fusion Application Server*. MedExpert/WWW can be accessed from any state-of-the-art WWW browser. Some applications are developed using Java and/or JavaScript. Therefore these features have to be enabled in the configuration of the browser.

Conclusion

Additional systems are under development and will be offered soon. Because of the rapidly growing importance of the Internet and of medical knowledge, interactive medical knowledge-based systems which are based on Internet and World Wide Web technology will become most important in the future.

References

Chizzali-Bonfadin, C., Adlassnig, K.-P., Kreihsl, M., Hatvan, A. & Horak, W. (1997) A WWW-Accessible Knowledge-Base for the Interpretation of Hepatitis Serologic Tests. *International Journal of Medical Informatics*, 47, 57-60.

Wireless Internet In Education In Developing Countries

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Abstract: This project report describes a Wireless WAN technology used by Chonia Informatica in the project Ghana SchoolNET for providing a direct Internet access to various University, Schools, NGO's, departments and other establishments scattered around the city of Accra, Ghana with a diameter of approximately 25km. A packet-based 2Mb/s Wireless Metropolitan Area Network solutions for Internet Access to link point-to-multipoint access servers.

Introduction

New developments in the use of the WWW and of multimedia materials in education like:

- Web-based technology to improve student academic,
- Online tutor or online professor,
- Virtual classroom,
- Distance learning,
- Virtual lecturing hall

increase the demand of bandwidth in delivering courses to Schools and adding new courseware on School servers. Modems don't have anywhere near sufficient bandwidth to allow entire schools to access the Internet at instructionally useful speeds. Leased T1 lines do offer enough speed 1.54 million bits per second (Mbps)--to connect schools to each other and to the Internet, even for heavy-duty multimedia use, but the lines are far too costly for most schools.

Wireless is a first real competition in developing countries, and I hope it's going to force ISP's to become more responsive to bandwidth demands.

We used wireless solutions over a two-month test period to connect an Academic Computing Center office with the University of Ghana, Legon.

Requirements for a Wireless WAN Network

The intended WAN imposes that the following requirements be satisfied with the following characteristics.

• Licensing	*Frequency license for 2.4 GHz transmission*
• Highest Visible Point.	*Territory survey to install Base Station*
• Farthest Access point	

The first requirement is particularly important if the country need frequency license before operation.

Wireless - Basic Functionality

The FCC in 1985 approved (47 Sec.15.257) three so called Industry, Medical & Science (ISM) bands for license free use:

- 902-928MHz,
- 2.400-2.4835GHz,
- 5.725-5.850GHz.

These bands are used by microwave ovens, garage door openers, and also spread spectrum radios. Current FCC regulations limit spread-spectrum radios to a meager 1-watt of power and confine their transmissions to so-called ISM bands. Yet despite these regulatory limitations, the inherent superiority of the technology allows the radios to cover 15km distances at speeds up to 2 Mbps. The radios can reach as far as 45km (with direct line of sight) and with the use of additional radios as relays, the range can be extended even farther. In part because spread-spectrum radios cause less interference, the FCC requires no license for their operation.

Configuration Overview

A dedicated PC based router running JNOS was used, keyboard and screen from this PC was removed when it was configured No hard disk required in this PC - DOS, JNOS and configuration file will fit on floppy disk. Cables, connectors, antennas, and amplifiers for installation

Aironet 2.4 GHz Direct Sequence Spread Spectrum Wireless Access Point and Client Adapters were used. To set up the ARLAN network, we used ARLAN 630 Access Point for the central site (Access Point is a "transparent" device that connects two media's: wireless LAN and wired Ethernet)

ARLAN 655 ISA adapters is mounted in PC routers for the client sites ARLAN 655 ISA adapters normally do not communicate directly, but all communication between ISA adapters goes through the central ARLAN 630 Access Point.

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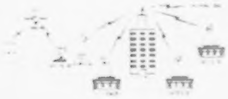
The distinct property of ARLAN is that several Access Points can be used to cover larger area; the Access Points themselves can be interconnected through wired Ethernet interfaces, or over radio, if one Access Point can "see" another Access Point. In this way it is possible to use an Access Point as a radio repeater to extend the range of wireless communication.

Point-to-Multipoint usable bandwidth measurements

In case of wireless LAN, one central node can "talk" to numerous "client" nodes simultaneously, thus requiring only one wireless adapter per connected client site.



The project implies the exchange of large amount of data over the network. It is therefore necessary to ensure that the network - and the supporting applications- is providing the performance required. Several services have therefore been evaluated:

- Ordinary TCP/IP links
- File transfer FTP
- WEB Browsing

The Client - Server Wireless Link

A series of measures have been performed to evaluate the behavior of these applications, comparing their respective performances. In all cases, the tests were performed between a Unix Server (ACC) and 14 PC's workstations networked at the University. The workstations are linked to the server through a wireless network 15km away from the Base Station.

The Server machine

The server machine stored small, medium and large files for FTP tests and gave access to files through a WWW server and through the simplified file-sharing protocol. The server machine used is a Unix server. This choice was made considering all functions it has to fulfill: WWW server, file server, etc. Such a machine is versatile enough to cope with all functions at the same time.

Communication Performance of Wireless and Ethernet LANs

The TCP/IP basic tests showed quite promising performances for the wireless link: up to 200kbps over TCP was reached in this configuration, which is fairly good considering that the additional bytes due to TCP/IP headers that are not counted in. The file transfers also benefited from the increase of bandwidth. Small, medium and large files were transferred across Ethernet and wireless, either one at a time or 4 at a time. After these promising results, we looked at one of the most used services between workstations, *Web browsing*. Again the test were performed with files on a server at the Academic Computing Center.

To summarize

We have seen that a high speed Wireless network delivers the expected bandwidth. However, depending on how the applications transferring data are conceived, this improvement can be counterbalanced by protocols not designed for higher speed networks. According to our measurements direct TCP/IP have an adequate behavior while the current Browser versions doesn't bring the expected performance increase. It is clear that due to the different nature of the information transfers, the problems are not the same.

Future direction

The system is still running and gaining acceptance in most African Countries, but some directions for future can be already be drawn up. There is a clear demand for an increased bandwidth, in order to allow multimedia applications like videoconferencing, access to multimedia data, etc. to be really usable.

The most important development will address the support for a Backbone system to remove backlag.

Conclusion

As the successful completion of our project has shown, wireless network will transmit signals with any bandwidth required, file transfer protocols will deliver requested data where needed.

There are political decisions that will shape the future. An example will be ISM frequency licensing.

Acknowledgements:

I gratefully acknowledge the support of Mikrotkls which share some of these visions and showed a keen interest and provided solutions. The importance of support from Mr. Arnis is gratefully recognized. Finally, it was a pleasure to work with Mr. Tetteh jnr. and the staff of Chonia Informatica without whose hard work, none of this would have been possible.

NETEST: A Significant Change in Internet Software

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Abstract: For the past three years, student programmers have developed a program called Netest. This software package consists of 30,000 lines of JAVA code. It has all of the capabilities of a multi-user system, network interface software, test generation package and statistical software. Netest is accessed through the Internet so people with accounts can use it anywhere in the world. It is currently being used at Utah State University to help implement the Computer and Information Literacy exams, a new requirement for all state institutions of higher learning.

Acknowledgments
We would like to thank NFS and FIPSE for their grants in making Netest possible. This project began three years ago in connection with these grants and we have been going strong since!

Overview

As the demand for technology increases, so does the demand for college graduates to be computer literate. A few years ago, it became evident the graduates from state funded universities in Utah were not as computer literate as one would hope. To address this issue, the Computer and Information Literacy requirement was implemented. The Computer and Information Literacy (CIL) requirement obligates students to show competency in six areas of Information Technology:

1. Public Networks and Electronic-mail
2. Computer Ethics
3. Computer Operating Systems
4. Document Processing
5. Use of Spreadsheets for Data Presentation and Visualization
6. Information Access via the Internet

Utah State University's CIL Implementation

In 1994, Utah State University formed a CIL committee consisting of at least one faculty representative from each college. This committee established the six competency areas. Students could take these tests until 70% competency was shown and would do so during their Freshman year. It was a great idea, but making it happen was the real challenge.

The committee decided to establish a testing facility where students could come in during the day, evening, or Saturdays and take the CIL tests. A computer testing system would need to be developed to store the data for each student, store the individual tests, administer the tests, correct the tests, score the tests and send the score in the student database, and gather statistics for each test and test question. It was also decided to use the Internet as the means to deliver this software environment to the students. Therefore, this huge testing program had to be accessible via the Internet.

In the Beginning

NSF and FIPSE grants assisted in funding the development. Student programmers were hired to develop the testing software, each working on separate tasks. The program was written in JAVA, the most logical high level language to be used because of its Internet capabilities. One of the tasks at hand was to develop a tool which would allow an Instructor to create a test. The test would be based on concepts and could consist of true false questions, multiple choice questions, fill-in-the-blank questions, matching questions, multiple answer questions, short answer questions and/or essay questions. The questions must be able to be randomized as well as the answer choices for the multiple choice questions. The test should be automatically graded with the ability to post a percentage score as well as a passing or non passing status.

Another task was to develop software allowing an instructor to make a performance based test. This is a test for which the student

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actually performs a task using a software tool, i.e. developing a document in a word processor or calculating statistics using a spreadsheet. The goal would be for the instructor to develop two files, one consisting of instructions or tasks for the student to perform and one being the initial file for the student to load and perform the tasks outlined in the instruction file. When the student finishes the test, the completed file is copied to a directory on the server where the instructor can grade it and manually enter a score for the student. Instructors would have a choice for tests to be always available for students to take anywhere, at anytime or to control the time and location at which a specific test is available. Also, a test can be "unlocked" for a specific amount of time for a particular student or class.

Additionally, statistics would need to be gathered. The system would produce information about each individual test (how many times it was passed the first time, the second time, etc.) and each individual test question (how many times each question was answered correct, incorrect or skipped.) These statistics may indicate a poorly written question, or perhaps one where the given answer was incorrect. Thus, allowing the instructor to make the necessary changes.

Once the ideas for the tests were complete, it was necessary to establish a student database to store all of the necessary information. This database would consist of names, student identification numbers, username and password used to enter the system, e-mail address and individual test statistics (i.e. which tests have been taken, passed, failed, still being corrected, etc.).

The next task at hand was to develop an environment which would control of the necessary processes. Three levels of access would be available — Manager, Instructor and Student. Managers could add, edit or delete Managers, Instructors and Students. They could unlock specific tests at the request of an instructor or student (depending on protocol). Instructors could develop, change and delete tests they "owned". They could manually grade the performance tests and update a student's test score. Students could take tests and be able to view their personal statistics.

An overall paradigm was established to help this process become useful in other testing environments. The model of a "class" was developed. Classes were made up of students. Tests belonged to classes. When a student viewed his/her statistics, the test scores were shown for the classes in which the student was enrolled. This allowed many tests to be developed for several classes and students would only be able to access the information belonging to their classes.

Final Product

Because of the flexibility of this program and the fact it was able to run on the Internet, other areas of the university became interested in using this product. Netest, the adopted name of this program, is now being used to administer tests for the CIL requirement as well as the History CLEP test and several other History and Engineering tests.

As the CIL requirement was implemented, it became necessary to develop interactive teaching modules for students to go through allowing them to "brush up" their technical skills. Again, these interactive tutorials, must be available via the Internet so students may use them at their leisure. Additional programmers were hired to develop these on-line tutorials.

CIL and Netest Today

A CIL lab was constructed, consisting of 24 Pentium based computers using the Windows 95 operating system. The software on these machines include the Corel Suite and Office 97. Each computer has access to the Internet and the University VMS system. The lab is staffed with consultants who unlock tests and answer CIL related questions, and technicians who set up the students accounts and maintain the computers in the lab. The lab is open from 7:30 a.m.- 10:00 p.m. Monday through Friday and 12:30 p.m. - 5:00 p.m. on Saturday.

The CIL requirement is outlined on a CIL Web Page (http://cilserver.ser.usu.edu/cil.html) as well as procedures for taking each CIL test. This web page links to teaching modules and other necessary information for students to pass the CIL tests. Students can study this information from anywhere and then come into the lab to take the tests. The lab is used to ensure test security and to eliminate cheating.

As far as the Netest system is concerned, to meet the demands of the CIL requirement several tests have been developed for each category so students do not take the same tests. Students come in at take tests at their leisure. The system keeps track of all the data associated with each student's tests.

Utah State University has several extension sites throughout the state. Some of them are more than 200 miles away. The students who attend school at these sites also need to take the CIL tests. Since the Internet is the means where these tests are given, it is very easy to have these centers implement procedures to give the CIL tests through the Netest system.

Netest is still being improved as well as the processes involved. It has been an incredible achievement to develop the Netest program — a program which administers accounts, tests, and people, and provides global access to all of this via the Internet. It is difficult to put into words the capability of this program. A demonstration would be more appropriate. Netest is definitely worthy of being shared with others.

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Retro-Engineering Medium Scale Client-Server Applications

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Abstract

It is easier to impose a coherent organizational structure on an application when the user requirements for the development are both well understood and relatively stable through the life of the project. This paper describes an experience of retro-engineering an application in which the user specifications were not well defined and were relatively unstable. The resulting application, while functional suffered from a number of problems, not the least of which was the difficulty in extending the application. The application was a web-based, client server application written using Java™ 1.02. With the rapid development of both Java and the browsers that support web-based applications, it became clear that the application would require re-engineering in order to remain function in the current environment. This paper describes the purpose and characteristics of the original application and results of the restructuring process and offers some comments concerning the benefits of the retro-engineering the application.

Introduction

Web Imaging and Remote Sensing (WIARS) is a web-based, client-server application providing large image analysis facilities integrating tools for boundary, cluster and change detection supporting image comparisons and change assessment. The application was developed as part of a SERDEP funded project supporting the monitoring of threatened and endangered species habitat on Department of Defense installations. For fiscal year 1999, the research team, including new team members, was presented with the task of rationalizing the interface, integrating an image registration module, and rewriting some problematic SAS routines in either C or FORTRAN. A surface examination of the existing code uncovered the need to perform a complete re-engineering of the application.

Analysis phase

The analysis phase involved a number of components. First an examination of the existing code was performed in order to determine a number of attributes including the functional structure of the code and the data structures employed. Data flow diagrams were developed to identify data flow and data storage requirements. Analysis of the communications requirements was also performed. The analysis phase provided the researchers with a clear picture of the original project as one that employed traditional functional decomposition, minimal data structures and data storage mechanisms, with a simple communications mechanism. The project consisted of a client and a server module implemented using Java™ 1.02 communicating through the socket and DataInput and PrintStream abstractions. The client functional and procedural structure consisted primarily of a single class with a large number of supporting methods enabled through one comprehensive event handler. The server module comprised a master process, distributing clients to slave processes. The slave process handled incoming data and processing requests and provided data storage functions. The primary function of the slave threads was to spawn external processes, typically SAS, MATLAB, FORTRAN and C routines that performed mathematical and statistical functions on large-scale graphical images. The second component involved the user interface. The interface consisted of a series of panels displayed in a main browser window, together with a large set of supporting frames. As a result of shifting user requirements over the life of the original project there was a lack of consistency in the organization, structure and presentation of each of the supporting frames. The limitations of the application development and client deployment environments were evident in the lack of coherence of the interface. The third component of the analysis phase involved examining the communications flow. Two forms of communication were identified, string communication, and image communication. The URL class was the primary vehicle for image communication. User identified images are identified through publicly accessible URL's and then ftp'ed to the server for processing. The final component of the analysis consisted of identifying the data storage requirements of the project. Data storage was performed only on the server. User and project information is stored at the server site in sequential files for user/password lists and project status reports. Direct access files are used to store project state information so users can resume projects without having to restart.

Object Modeling

Having completed the analysis phase and given the current project requirements, a decision was made to utilize the data flow information and data storage requirements from the original project but completely redesign the user interface, data communications and data storage mechanisms. Central to the redesign was the utilization of a coherent object model that encompassed all three areas and allowed for rapid extension of the project functionality. The design of the object model reflected the major areas of concern. Independent class structures were developed for the user interface, for communication and for data storage.

The GUI was designed with three main requirements; first, all the main controls for the interface had to be available within a few clicks or key presses from any other point in the project, second, the controls should be consistent across all segments of the interface and intuitive for the user, and third, the interface should be contained within a single frame to reduce the complexity of the presentation.

The client side can be structured into a sequence of tasks; login, project and image management, GIS attribute specification, process specification and output specification. As a result the GUI was constructed with major controls for accessing. Accessibility to the later controls is managed by a login mechanism. After successful login, existing or new projects can be managed. Image attributes can be set, analyses performed and output requirements specified. A status screen displays the current project state and logs project activities.

Within each tabbed panel, an indeterminate number of screens may be required in order to capture all the data required by one segment of the application. To accommodate this each tabbed panel acts as a container for a wizard object. The wizard, selected because it is a familiar mechanism to many users, provides a framework for display, controlling and navigating through multiple panels. The final component of the interface is the Panel extended to provide title and placeholder components and to provide consistency across all Panels in the interface. Much of the development process of the user interface consists of designing appropriate panels and the sequencing of the panels within the framework.

Three primary data classes were identified, a user class, a project class and an image class. Each of the classes functions as a data storage module with facilities for controlled retrieval of the data. The user class contains basic user data to allow login and project management. Typically the user class is used to retrieve information about current projects. The project class manages project status information. The project class includes owner information, image information and status information on the project. The project class allows a partially completed project to be stored. The image class contained information concerning the location, type and attributes of images used within a project.

All three data classes are communicated between client and server at intervals through the processing of a project. For example during the login phase, a user object is populated with login information and then passed to the server for verification along with a processing request. The server responds with potentially additional user information, project information and other control information. The primary medium for communication is the ObjectInputStream and ObjectOutputStream. To allow objects to be sent though a socket both client and server need at least a common object prototype. A communication object was designed comprising service request information and a generic object container that utilized polymorphic capabilities to allow user, project and image objects to be passed within the same communications object. This approach allowed the researchers to consolidate all communication on a single port. The generic Object class provides facilities for interrogating an incoming object to determine its source class for appropriate casting.

Building an Internet Knowledge Support System for Nurses

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Our journey in developing the **Internet Knowledge Support System** (IKSS) began with our quest to improve the delivery of distance education to practicing nurses enrolled in the undergraduate program at Dalhousie University School of Nursing in Nova Scotia, Canada. The School of Nursing was challenged to provide university education to nurses who were employed full time, had primary family responsibilities and limited access to academic resources. At first glance, quality distance education systems are more complicated than face-to-face learning systems because of time and geographic variation and the lack of mental models for faculty, administrators and students. The IKSS provides a model of delivery which responds to the demographics of this unique population and values interactivity in the learning process. World-wide experiences with distance delivery of education have shown that effective learning occurs when methodologies are chosen to fit the content but also provide opportunities for interactivity and learner independence. Traditional distance education strategies usually focus on only one of these factors. However, our experiences with **web-based learning** technologies have shown ways to ensure mastery of content while encouraging both interactivity and learner independence.

The IKSS is based on principles which arise from the contructivist paradigm. The notion of the constructivist theory is that people learn best by actively constructing their own knowledge. This paradigm is well suited to Nursing which values a holistic, experiential model.
The key principles of IKSS are:

1. **Learner Focus** The system is flexible in approaches to course content and assignments with recognition of diversity in student learning styles and the students previous knowledge and experience. Learners identify gaps in knowledge and seek relevant resources to fill gaps.

2. **Interactivity** The expectation is that students are accountable for their own learning. They must be active in the process by contributing to the

learning environment, interacting with their peers and resources (content experts, literature, web resources).

3. **Context of the learner** The Constructivist's view is that learning is affected by the context of the learner. The model provides learners with the opportunity to construct new knowledge from the context of their personal clinical/learning experiences.

The relationship between these three principles is the value placed on each individual student's contribution to the learning environment and their ability to fit new information with what they already know.

The IKSS model provides a collaborative web-based learning environment where nurses interact with a variety of information resources using multiple pathways. Examples of the web-based environment include: case study activities or short tutorials with content experts in real time through chat rooms, bulletin board or email opportunities for asynchronous discussions with peers and content experts, and links with relevant web sites and online journals. Assessment of student progress occurs using multiple strategies such as online quizzes and presentations, participation in bulletin board discussions and chat rooms, and submission of scholarly papers. Students are also able to monitor their own progress throughout the course.

To date we have offered 7 different web based courses to approximately 100 nursing students using the IKSS principles. Evaluation data related to access, active participation, student learning and support have been collected from students and faculty. Overall student and faculty feedback has been positive and instrumental in building the Internet Knowledge Support System.

Figure 1. IKSS Model

Online Assessment with Large Classes:- Issues, Methodologies and Case Studies

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Abstract. Currently at UWSM, an in-house developed, web based teaching delivery infrastructure called PlatformWeb is being developed. In the current teaching semester there are over 3,000 students across 200 subjects using it in conjunction with traditional teaching methods. PlatformWeb has modules for various online assessments including online quizzes in a variety of delivery modes; and online uploading and marking of student work, along with the automatic display of progression to students. This paper presents methodologies and issues relating to the needs, management, implementation and operation of conducting a range of online assessment activities with large subjects.

Introduction

Because of the raw number of students and the associated supporting staff, large subjects have particular problems relating to consistency and equity of assessment, administration and coordination and the handling of student problems, needs, concerns and arbitration (such as issues of cheating, absence, lateness and disputes). When moving to online web based assessment, the issues of student access, network reliability and performance, off campus verses on campus supervision, feedback to students, logging, issuing of receipts, the timing of progression results to students and other related activities need to be addressed.

The PlatformWeb Project

The PlatformWeb project was introduced to the University of Western Sydney Macarthur in 1998. This project aims at providing a complete Web Information System for teaching delivery. It integrates with the student administration system to provide a single entry point for all staff and students to access their subjects. PlatformWeb has been designed along user-orientated design principles [Hansen, 1999], with its specifications and functionality developed from staff perceived needs, feedback and experience. Besides providing various content delivery and messaging functions, it also provides a range of online quizzes, student uploading of assignments and online automatic progression modules. The user orientated design has been receptive, in particular, to the needs of large subjects (excess of 300 students). Also drawing on previous LAN based work with paperless subjects, various features and logistics for large subject online and web based assessment have now been included. Many others have been identified and will be incorporated.
From a study of staff perceptions of needs and problems with teaching delivery in the educational environment. The major (70+%) of problems related to the lack of administrative support. For large subjects, moving onto the web has made some of these support functions even more important. For example, with 900 students, without an accurate and timely provision of student enrollment data, a web based delivery system with logons will have constant problems of student access and staff management. From staff surveys, there can be a considerable loss of teaching time (up to 4 weeks) at the start of a teaching period in addressing these problems.

The PlatformWeb project, from the beginning, integrated with the administration information systems, making it a possible platform for staff in bulk (rather than just the "innovators") to make use of the Web medium. In particular, the integration allows many problem areas in teaching delivery in large student subjects to be addressed. Two such areas are given in this paper, namely online submission of assignments and online quizzes.

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Web based assessment submissions with large subjects

The PlatformWeb project enables an instructor to set various assessment items and include them in the subject delivery. The submission modes, in keeping with the PlatformWeb design, have been developed from staff experiences and perceived needs. With large subjects, the management and verification of student submission by traditional paper means has typically involved problems of late submissions, lost or misplaced material, disputes over submission, lateness of marking, returning material to students and coordination and consistency of marking. Increasingly students are now preparing work that is web based and this has also meant setting up complex link tables and logons to web sites for staff review and marking, along with the logistics of adding comments and feedback to students. Based on these concerns, the PlatformWeb submission module has two submission modes. An instructor can either set an assessment item for students to upload a file or files (of any format except for executables and the like) or to upload a link or links to an associated web site. For the submission of files, the number of files, overwriting and viewing of the submitted material can be set. For all student submissions, every upload is time stamped, logged and an online receipt is given. This enables an orderly management of student queries and submission problems. The inbuilt progression module of PlatformWeb allows the marker to view the student files or links, add marks and comments that appears on the student progression area. In addition the display of the marks can be disabled, allowing for all markers to complete marking and a comparison of the marking scales used, before becoming available for student viewing (inevitably with large subjects some revision of marking scales is needed, with online automatic progression students do not appreciate seeing a given mark changing). Another area being addressed is the partitioning of student progression and marking, not only into groups (horizontal) but also into various vertical modes. With a large subject of say 900 students, the actual download of the data can take considerable time.

In addition, from staff usage, with large subjects, the need for a variety of reports has been flagged (and will shortly be implemented). These reports cover the status of submission, the allocation of groups to different markers and various statistics to assist an equitable marking.

Web based quizzes with large subjects

Similarly, applying the user orientated design approach, the quiz module in PlatformWeb has particular emphasis on the management of quizzes in addition to the delivery modes. The general philosophy is to upload question banks and then form quizzes from the banks. A variety of delivery modes have been developed to cater for enabling, reviewing and repeating quizzes. Quizzes can be formed either as a fixed sequence of questions, a randomised set from a bank and for large classes with multiple groups, a randomised per session mode. This mode sets the same set of questions for a "session" but a different selection for another session (there may be 20-30 sessions in some large subjects). This allows a set of questions to be reviewed on a class basis, which is not possible if every student has a different random selection. Also a variety of delivery modes are available giving password quiz enabling, time window enabling, time windowing for reviewing, options for recording marks or repeated quizzes and similar. Needs for large subjects include the ability for a marker to actually review the quiz of any student including a timestamp of when a question was answered, the actual answer and the number of attempts. In addition is the ability of a marker to reset individual student quizzes. This becomes particularly important when there are many hundreds of simultaneous users with various internet response times and variable network performance. All of the above has been incorporated into PlatformWeb and a variety of staff and student feedback is now being collected for incorporation into the system.

Conclusions

This paper presents various issues that can take on special importance with web based delivery for large subjects, particularly if the web delivery is being used in conjunction with traditional teaching modes.

References

Hansen S. et all (1999),*Adoption of Web Based Delivery by Staff in Educational Institutions: Issues, Strategems and a Pilot Study*, Proceedings of Ausweb99, Ballina, Australia 379,395

Intrinsic Human Interest in Internet Use

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Abstract: The numerous advantages of the Web for delivering distance education have overshadowed issues of student learning preferences. While some individuals who have no access to computers and web technologies report an intrinsic readiness to participate in Web-based courses, others who have computer and network access and are familiar with the Web express a strong unwillingness to take (or to continue to take) Web-classes. Preliminary analysis of longitudinal data points to a refinement of self-reporting on nonuse from the more generalized categorizations of "values & principles" and "anxieties and phobias" toward a more specifically articulated but broader range of intuitive reasons for non-participation in a primarily asynchronous learning environment. This shift has occurred even as their primary computer use has shifted dramatically from word processing to e-mail and Net-based activities, while the number of those "ready and willing" to take Web-based courses has dropped from over 55% to under 40%.

Background

Discourse about cyberspace, including its use in education, is generally framed within the context of the technology itself rather than as a part of a larger universe that includes non-user populations. Even the most conscientious members of the debate focus on non-users primarily in the context of universal access, the digital divide, or haves and have-nots, in effect placing all non-users in a single category of "wanting to, but being unable to" participate in this digital universe. Clearly, within the nonuser population there is great and growing demand to obtain access to the technology and it is not my intention to downplay the immense need for opening the network to those whose access is blocked by economic or technical bottlenecks. This study augments the already-well-covered tangible domains of non-use by focusing on a smaller, but still significant, portion of our population who have identified shortcomings in the current system that are incompatible with their personal learning and or communication styles. In other words, rather than view the non-user in terms of how we can "get them on board" as consumers, this study articulates some of the most commonly voiced concerns that tend to preclude certain individuals from participating in Web-based, asynchronous educational programs. The primary goal [illegible] this study is to legitimize the values embodied in the non-user population response to the Web vis-a-vis education and learning; and in turn remain open to the possibility that such valid issues may form the basis for a different and as yet unexplored alternative to our current models for Web-based learning.

Sample Population and Methodology

My studies of low-use to non-use populations have been conducted through surveys as well as one-on-one and small group informal interviews in educational, private, and public settings in Hawaii. The time frame encompasses the life span of the World Wide Web with a comparative study of two similar groups of undergraduate cohorts in 1996 and 1999 used for statistical analysis. The latter group represents students registered to take the introductory course in Communication during Fall semesters of 1996 (N=99] and 1999 [N=88] who responded to an identical set of questions, with an additional refinement of a question in 1999. (In 1999 in addition to being asked if they felt they were "ready and willing to take a full college course taught primarily through e-mail and the World Wide Web, they were also asked if they were "ready for a course ENTIRELY on the Net.") During the past two years similar methods involving informal interviews were used to extend the study in the Continental United States, as well as several European and Asian countries and Eastern Canada. All such interviews were conducted in English and were a part of a much larger effort to gather data on everyday uses of new communication technologies. This is a preliminary report on an ongoing synthesis and analysis of this aggregate data, with specific statistical focus on student surveys at the University of Hawaii at Manoa.

Preliminary Results in Context of Current Literature

Adoption of new media for educational purposes can be studied from the perspective of educational institutions delivering the service or they can be viewed through the eyes of the potential user population. Clearly, without service providers' taking the first step to take advantage of new communication technologies and to create these innovative learning environments, students would not even face a choice in alternative modes of learning. Once such services become universally available, however, we can begin to assess their outcome and future direction. Models for assessment may be located within the educational framework [for example, Houle, 1996; De Diana & van der Heiden 1994]; focus on the technology [as in Lin, 1998; Atkin, 1995]; take a particular social construction approach - for example, reasoning that economic status is the only determining cause of non-use of technology [Greenstein, 1998]; or take a meta-perspective [such as Rogers, 1995] in anticipating trends for the adoption and diffusion of such new delivery mechanisms.

The current study addresses compatibility issues between technological innovations and pre-existing human values, learning styles, personal traits, characteristics, and predispositions that affect or inhibit what some students refer to as "peak" learning experiences. In other words, there is little debate that, given no alternatives, students are quite able to learn through a variety of remote, asynchronous, and self-paced methods of instruction. But given a choice, what is the learner's intuitive experience in peak learning experiences? Preliminary results from this study indicate that individuals are capable of articulating these nuances in a variety of ways that can be categorized in the following overlapping yet distinct domains of personality and physiological traits, attitudes & perceptions, and circumstantial, environmental or peripheral concerns: (1) *personality traits* (such as not having enough patience, self-discipline, structure, or intrinsic motivation for Web-based learning or simply not having an inherent interest in the medium, thus getting bored); (2) *physiological traits* (such as getting sleepy in front of a computer screen or having more reading difficulties or experiencing disorientation; or needing the multi-sensory, three-dimensional stimulation of a live classroom setting for optimum learning); (3) *perceptions of needs* in communication environments (such as equating face-to-face interactions with "personal" and "animated" satisfaction while considering any form of computer-mediated interaction as "impersonal" and inanimate); (4) *mis/perceptions of technology* (as lacking real interactivity or as being impersonal, incomplete, or complex beyond personal grasp); and (5) *circumstantial, peripheral, or environmental* concerns (such as lack of control, lack of immediate access to faculty, distrust in the remote evaluation and assessment process or quality control). To these can be added a palpable sense of loss felt by many: a loss of intimate feedback, relationships, and necessary social experience.

References

Atkin, D. (1995). Beliefs about computer-mediated information services among college students: An exploratory study. Telematics & informatics, 12, 1-10.

Greenstein, S (1998). To have and to have not. (use of computers at home). *IEEE Micro*,18 (1), 76.

Houle, P.A. (1996). Toward Understanding Student Differences in a Computer Skills Course. *Journal of Educational Computing Research*. 14, n1, 25-48.

De Diana, I.P.F. & G. van der Heiden (1994). *Electronic Study Books and Learning Style*. Journal of Computer Assisted Learning, 10 (2), 113-24.

Lin, C.A. (1998). Exploring the personal computer adoption dynamics. Journal of Broadcasting & Electronic Media, 41 (1), 95-112.

Rogers, E. M. (1995). Diffusion of Innovations. (4th ed.). Free Press. New York.

In-Service On-Line: 'Computers for Lunch!'

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Objectives:

Based on a need identified in the conduct of field research with the GenTech (gender/equity/technology) project (http://www.educ.sfu.ca/gentech/) on the equitable implementation of new information technologies in classroom learning activities, the present project's goal has been to design a "deep" website, a maximally interactive, richly scaffolded, activity-based instructional resource for teachers wishing to learn about computer fundamentals. Utilizing the WWWeb's "anytime, anywhere" accessibility allowed us to respond to teachers' concerns about already over-burdened work schedules, by creating a web-based program, "Computers for Lunch," designed in 20-minute instructional segments which learners can access at home, at school, or anywhere else there's an internet connection.

The program itself is free and its instructional activities all use either "shareware" programs, or programs (such as "Clarisworks") which are widely available in public school computer sites. A subsidiary goal of this project was the field-testing and modification of the program, based on user feedback.

Because the site is extremely large, we will show segments of it in relation to two themes which have emerged for us in thinking about how to create better educational software. They are (1) community and (2) interactivity, specifically, for us, *educative* or *pedagogical* interactivity.

1) Community, and questions of audience

As educators our task is a pedagogical one, a task of forming relationships of a specific kind, relationships which are educational ones, first and foremost. In this work we follow the insights of cultural activist and popular education pioneer, Paulo Freire, who advised that we must be learners in order to be teachers, and before embarking on any educational project, you have to find out what it is in your particular local cultural context that people already know, what their daily lives are like, their systems of value, their affections and interrelations, local threats and dangers, and the like.

And that's how we ended up with the core concept and the site name, "Computers for Lunch." The **teachers** told us that they had no time at all for professional development or inservice, no time for anything which wasn't very practical and directly relevant to their teaching, and that their existing commitments meant that if workshops were offered **after** school, they simply would not be able to attend them. Remember that our audience here is elementary teachers, a 97% female workforce, so most of these women have children of their own to get home for, and their evenings are fully taken up with childcare, shopping, cooking, dishes, their own kids homework and only then, the most essential classroom preparation, marking etc---They opted for lunch hour workshops one day a week, and they told us "the secret of success here is if you want teachers to come to a workshop, provide food." So here we have a lunch-hour workshop, designed in 20-minute segments to be done once a week, which provides virtual food. And of course a way to introduce the idea of selecting computer based activities from a menu becomes a familiar one with this metaphor of a diner menu, in which each activity is a different virtually edible dish.

The program is based in activities which fit into existing curriculum contexts, and represent the range of computer-facilitated practices prescribed by Ministries of Education in BC and in Canada more generally. This activity-based approach to instruction is starkly contrasted with the kinds of programs currently available which try to achieve the same goals--and we will show some of these-- using basically pages and pages of text with far too much useless information, lots of alienating language, and no context, in particular no obvious classroom application.

2) Interactivity, specifically pedagogical interactivity

One of the most crucial considerations of this project, we've tried to indicate, was the question of audience - and not only in terms of what technologies that audience did or did not have access to. Avoiding the impulse to "address everyone"-- because in doing so it's all too easy to end up speaking to no one--we've focussed much of our attention on the question of audience, so when we think about interactivity we think about both about how to "address" this particular audience and also, just as importantly, about the kind of audience we are going to construct. Decisions about content and presentation, we think, have to do with how we fashion a particular kind of audience, and cultivate particular ways of knowing and learning. Questions of addressivity and audience, then, shape our understanding of interactivity, especially of what we call **pedagogic interactivity**, interactivity driven by questions of how human subjects are constructed in and through ways of knowing and learning. We wanted to, as much as possible, move away from more machine-based conceptions of interactivity whereby the user does something, the machine records it and then reacts to the user, doing something back to her. In educational technology, this is one of the most familiar and pedantic forms of interactivity, where the user is asked to demonstrate competency at a particular skill before she can move to the next skill; her "progress" through the program is recorded and then used as proof of competence or incompetence of that skill. We tried to think of types of interactivity that invoked a different set of relations, relations which maximized learner agency. By scaffolding activity-based learning, and we sought to enable performance before competence, to assist users to succeed at computer-based practices as a means to learning how to do them. The interactivity in this program, then, is then less about a machine or software reacting in sequenced and structured ways to what the user is doing and more about maximizing learners' freedom to determine what they want to learn, with the program guiding their activity, sometimes simply by "modeling" a particular skill which the user can then imitate. This way of understanding interactivity meant figuring out ways of scaffolding learning such that successful activity could be co-produced by the learner and the content, making one of our tasks that of imagining possible ways of learning about software that did not presume user identification with a pre-existing technicist discourse. So the content we created, for example, did not take for granted familiarity with terms like tool bars, menus, a desktop and so on. Instead, we tried to find a way of executing technical skills that recognized that for these users, technicist discourse is far from transparent. Rather than interactivity being a kind of entertaining add-on, then, we have tried to make the content itself, in effect, "always already" an interactive response to the users we are addressing. The point here is just to acknowledge a significant difference between what counts in*technical* terms as interactivity, and what might count **pedagogically** as such.

Outcomes

The easiest way to assess this project's outcomes is to go to http://www.sfu.ca/~cfl, where the program is presently on-line. There are two sections (graphics and video), which will be on-line very soon. If a user "logs on" as "cfl", s/he will however be able to see some of the graphics section--not yet available to outside users. Users could also go to a section under development at http://www.sfu.ca/~cfl/dw_index.html

Conclusion

We'd like to conclude by coming back to the inter-related issues of communities and audiences, and specifically to the ongoing debates about the perils of confusing so-called "real" and so-called "virtual" communities. There is a great deal of talk about the need (depending upon one's "social orientation") either to create spac nvironments, a "home" in *virtual* communities; or else, from those on the other side of the issue, about the need t habit and to be a full and engaged participant within, *actual*, 'enfleshed' local human communities.

For us, however, the work we have been doing illustrates ways in which these two kinds of community might be optimized only to the extent that they can become conjoined, hybridized new forms of community. We are finding that we need to build a resource addressed to the specific people, and the specific capacities and constraints, of our intended user-communities, in order to create an on-line environment in which spatially and temporally dispersed users **could** form an on-line community. But this is itself only viable as a community of practice to the extent that the virtual relationships and exchanges "pay off", i.e. have a real application and use in the actual world of real teachers and students in particular local, face-to-face classroom communities.

Evolution of Strategic Web-based Communication in Organizations: Webmaster Survey

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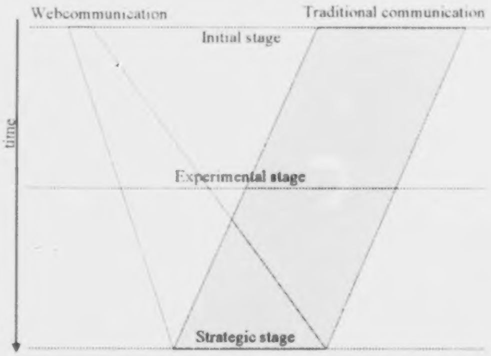
Abstract: The focus of this research is to obtain insight in way that organizations apply Web communication in the integration in their overall communication strategy. It is hypothesized that as an organizational site develops along the continuum from promotional (in which the site primarily replaces print communications) to transactional (in which the site is fully integrated in the organization's strategy) different organizational structures and personnel skill sets are needed. A Web-delivered questionnaire to investigate the evolution of Web sites, their organizational centrality, and the changing roles and qualifications of communication professionals responsible for the sites is described. Data from Webmasters around the world is currently being collected on-line, and preliminary results will be presented.

An integrated research program focusing on Web communications was begun in September 1998 as a joint effort between the Communication Research Laboratory in the Department of Communication Sciences at the University of Connecticut and the Research and Development Institute for Information Technology and Communications at Fontys University in the Netherlands. The overall research program has these objectives:

- Describe the basic taxonomy of Web sites, based on their strategic uses in different organizations.
- Develop a measurement instrument based on the characteristics of sites and their host organization that can be used to classify sites according to the site's strategic position in the organization.
- Chart and predict the evolution of sites from one strategic position to another.
- Determine the personnel skills and characteristics necessary to establish and operate each type of Web site.

A primary question involves the progression of an organizational Web site from one type into another. Each type of site requires a different composition of skills and leadership. We propose that as the site develops along the continuum from promotional to transactional different organizational structures and personnel skill sets are needed. During the initial site implementation, the company typically is unsure about how to exploit the Internet. The implementation team is usually part of public relations, marketing, or information technology, and may be housed in any of these organizational locations.

As the site becomes more central to the core business of the company, the Web team moves to a more central position in the



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organizational structure, and Web communication is integrated with traditional communications, as illustrated in the accompanying diagram. The identity of those responsible for site operation is likely to change as a consequence. It is hypothesized that promotional sites move to being customer relationship or business-to-business sites. A single promotional site move evolve into either type, or may combine types in a single site, or may bifurcate into two sites, one customer relationship and the other a supplier network or other business-to-business site.

At the transactional phase, the site and functions are reintegrated, and the management team moves to a finance or operations position in the organization. The site becomes central to the strategic plan of the organization and it is again likely that different educational/skill requirements for Web managers will emerge. The evolution of pure portal sites is not clearly understood. They are essentially independent organizations, rather than operational parts of a larger organization. They may represent an immediate establishment of a transactional site type, bypassing the preceding evolutionary phases. Congruent with the evolution of the Web sites it is the expectation that the use of the communicative possibilities of the Web will increasingly be integrated with non-Web business communication.

The research in progress investigates the evolution of sites at a large number of organizations. To do this, an efficient method of characterizing the developmental phase of a site is being developed. Therefore, much of the research currently focuses on developing and validating a classification instrument. This instrument will be used to characterize the stages of development of existing organizational Web sites. It will also be used to study the transition of sites from their prior phase, and to predict their transition to future phases.

As the position in the organizational structure of the Web site changes, we propose that differing skills and educational backgrounds will be required of Web site team members. The research will investigate the organizational titles and desired team member skills reported by Webmasters in sites at each phase of development.

A Web-delivered questionnaire has been developed and is currently being used to gather information from a large number of organizational sites. The World Organization of Webmasters (WOW) has placed a banner on their site for respondent recruitment. This will provide access to Webmasters in a wide range of organizations in the U.S. and other countries. In addition, an international sample of Webmasters from a commercial e-mail list organization is being recruited by e-mail. The questionnaire is being hosted by the Web survey research organization Swift Interactive Technologies (Hopkinton, MA). The database of responses will be used for the statistical description and analyses required by the research questions.

The questionnaire collects information from three time periods, corresponding to the past, present, and future organization of the site. A series of questions follows this general form:

(1) In the past, what was your Web site like (e.g. "How many persons devoted full time to the Web site before your last Web team reorganization?").
(2) What is the Web site currently like? (e.g. "How many persons currently devote full time to the Web site?").
(3) What are future plans for the site? (e.g. "How many persons do you expect to devote full time to the Web site when you next reorganize the Web team?").

The same three-part approach is utilized in a series of questions about the skills and training required and/or desired of Web site team members. The questionnaire also contains items about the organization's size, primary business, organizational structure, etc.

The comparison of the answers to each set of questions will give:

- A description of the current state of development of Web sites in differing organizations. Organizational type information from the questionnaire will be used to break down the site types by industry (e.g. manufacturing vs. information sector), size of organization, etc.
- The frequencies of transition from one phase to the next. This will confirm or disconfirm our hypothesized sequence of development of strategic Web sites.
- The description of both the changes in the degree of integration between Web communication and regular ways of communication and the departments or people involved with the management of the company.
- A prediction of the types of Web sites likely to operating in the near future.
- A description of the skills and training likely to be in demand for Web team members in the near future, and how these differ from the skill sets required in the past and those currently defined.

Cultural, Ethical and Technical Considerations in Leaver vs. Taker Communities: Incentives and Barriers to Providing Universal Internet Access

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Abstract: There is currently underway a concerted effort on the part of industrialized nations to bring both the traditionally disadvantaged citizens within their borders as well as citizens of developing nations into the online fold. The work outlined in this short paper addresses this universal access phenomenon by considering the growth of the Internet in terms of *Leaver* and *Taker* users—idioms usually associated with a culture's interactions with its environment. Leaver cultures interact with their surroundings in a sustainable manner while Taker cultures produce in excess and tend towards imposing their ways upon others. The Internet is explored as a community of users, which in its current state is dominated by Takers. However, realizing the need for a more heterogeneous Internet community, this paper explores incentives for Leaver cultures to participate in the development of online content and methods for improving interface designs to be more intuitive to Leaver communities. Through their participation, it is hoped that an impending "tragedy of the commons" can be avoided with regard to the current exploitation of Internet resources as more Leavers become involved in nurturing the Internet as a valuable tool for all communities.

Whether you agree that access to technology in developing nations is detrimental to the maintenance of their cultural heritage, the reality in the world today is that a predominantly Western approach to the use of technology is subverting these cultures at an accelerating rate. A new form of cultural imperialism is emerging as tribal communities become wired to the Internet, gain access to satellite television, and begin using global positioning systems to enhance their agricultural productivity. Many Westerners who favor the preservation of traditional, indigenous cultures tend to take a negative view of this phenomenon. Yet, if there is money to be made in the process, it is inevitable that some multinational corporation will find a way to bridge the divide that separates first and third tier cultures for the purpose of opening new markets for their high-tech wares. It is essential, then, that we think critically about the role that the tools and interfaces we create play in human evolution and everyday life.

Ever since the dawn of the agricultural revolution 10,000 years ago, humankind has embarked on a split cultural path. Daniel Quinn's book *Ishmael* explores this diversion of Leaver and Taker cultures to show how the dominating *Mother Culture* in Taker societies is devouring Leaver cultures at the expense of a sustainable environment. Traditionally, Leavers see immediate resources as necessary for survival whereas Takers see resources as a commodity to be exploited. Similarly, the Internet, while once a more balanced community of Leavers and Takers, is becoming a more uniform clique of Taker users. In the guise of "progress," developing nations and tribal cultures (i.e. Leavers) are dying out as broadcast telecommunications saturate the airwaves with what is primarily a Western worldview. It was perhaps inevitable that the "network of networks" that is the Internet would again take on some of the attributes of the Taker culture that spawned it as an ever increasing number of users migrate online intent only on searching for information relevant to their specific interests. Unbridled growth tends to destabilize any system and the Internet is no exception to this rule.

But how does one address the issue of communication with people from extremely disparate cultural backgrounds? When the medium of communication involves technology, the key is a well-designed user interface. A technology that is both transparent and complementary to a given culture's existing tools will almost certainly be the most effective. In other words, the best technologies are intuitive and the procedures for learning how to use them are deeply ingrained within a society's cultural practices. If an individual from a given background can interact with a technology with little or no effort devoted to navigating the space that separates his or her five senses from the task to be accomplished, then the interface is successful. By subtly stepping out of the way and removing itself from the process, the interface is doing its job efficiently by not interfering with the experience. In order to make this happen however, one must build interfaces to technologies that are meaningful to those that use them so as to enable the users to freely express themselves and engage in a synergistic exchange of information with the rest of humankind. If Taker cultures simply school Leavers on the Taker approach to interacting with technology, the best that can be hoped for, in the way of meaningful output, is a slightly morphed version of the Taker perspective—an echo. What we need are fresh perspectives, not more redundant information.

The perfect interface alone, however, will not eliminate all barriers to the adoption of new technology. Many primitive cultures use literal versus symbolic representations to transmit a particular message. For millennia, the Aborigine of Australia have used rock painting as a way of communicating with each other over great expanses of space and time. An interface consisting of the standard keyboard and mouse may well prove awkward for an Aborigine to master whereas a large format, pressure sensitive flat panel display that could be hung vertically and painted upon by hand might provide a more intuitive means of expression. Neoteric interfaces such as this and those being developed at MIT and the University of Washington's HITLab could enable cultures unfamiliar with Western symbolic representations to express themselves fluently in the new medium. Perhaps a design team consisting of an anthropologist, Aborigine, graphic designer, and user interface designer would be better equipped to design a "One World" graphical user interface. Such a team could incorporate their unique combination of technical and cultural perspectives to create a context-based system where the user model becomes identical with what is displayed onscreen.

It seems a bit patronizing and paternalistic for those of us accustomed to the widespread use of technology in our everyday lives to conclude that traditional cultures are too inexperienced to cope with the negative influences that technology is certain to have on their cultural character. The authors are not advocating the assimilation of indigenous cultures but are attempting to adopt a realist perspective towards the problem of technological encroachment. Given that the adoption of First World telecommunications technologies by tribal communities is an unavoidable fact in today's modern world, the authors seek ways to ameliorate the negative influences that these technologies may have on the unique aspects of indigenous cultures. Encouraging tribal cultures to participate in the development of Internet content and new interface designs can only reduce that impact. Our work in this area is an attempt to open discussion, provide some cultural context, and initiate a dialogue with Leaver communities based on mutual trust, respect, and a sincere desire to imbue humankind's digital archive with multiple perspectives.

Building Web-Based Technology Training for Teachers: A Case Study

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Abstract: Since 1992, the Institute of Computer Technology (ICT) has offered a Technology in Education Certificate program in partnership with the University of California, Santa Cruz Extension, to train thousands of teachers in using and integrating technology into instructional programs. In a cooperative arrangement, the University offers quarter units of credit for classes, and ICT provides the copyrighted curriculum and teachers. This paper describes the collaborative efforts of three partners (the University of California, Santa Cruz Extension, the Institute of Computer Technology, and Kaleidoscope Software), beginning in 1998, to adapt and develop the Certificate program to offer technology teacher training via the World Wide Web.

1. Introduction

The Institute of Computer Technology (ICT) is a non-profit public agency that provides technology training and planning services to both schools and industry. Authorized by an act of the California State Legislature in 1982, ICT's primary mission is to improve the technological capability of public schools and the training of teachers. Since its founding, the Institute of Computer Technology has partnered with school districts, the State of California, and a number of local Silicon Valley high-tech companies (e.g., Hewlett-Packard, Intel, Microsoft, and 3Com). A Board of Directors that is composed of three elected representatives from education and four appointed representatives from Silicon Valley high tech companies governs the Institute. Currently, ICT is operating technology-training programs at various sites including California, Texas, Oregon, Washington, Massachusetts, Arizona, New Mexico, Georgia, and Washington, D.C.

Additionally, ICT offers over 60 courses covering a broad range of Windows and Macintosh applications and computer programming; customized training programs (one-hour workshops to multi-year programs) for teachers, administrators, and support personnel; customized curriculum development, training manuals, and instructional materials; assistance in preparing/updating school technology plans, district and school technology audits, and technology courses for K-12 students; assistance in establishing student and teacher technology standards; assessment of classified and certificated personnel computer skills; and piloting of new instructional technologies.

2. Early Development of the Technology in Education Certificate Program

In 1992, a partnership was established between the Institute of Computer Technology and the University of California, Santa Cruz Extension to develop a Technology in Education Certificate Program. Completion of the Technology in Education Certificate Program (10 required units and 5 elective units, totaling 150 hours of instruction) would provide a systematic, sequential learning approach toward the use and integration of technology into instructional programs, teaching, and administrative assignments. The classes were held in ICT's facilities utilizing their computer equipment and copyrighted curriculum, and taught by experienced and qualified classroom instructors. The main goals of the program were to: (1) prepare teachers to teach in a subject area, and (2) prepare teachers to teach using technology in the classroom. Each class would include hands-on training and a usable classroom activity to integrate computers and other educational technologies into an ongoing curriculum. Various electives would offer hands-on experiences using technology to enhance learning in specific curricular areas.

Advantages and incentives for teachers taking the program include: (1) possible reimbursement and advancement on pay scales, (2) fulfillment of the requirements for a supplemental authorization in Computer Concepts and Applications for the Multiple and Single Subject Teaching Credential, (3) promotion of personal achievement, (4) options to clear one's credential, and (5) fulfillment of professional growth requirements. An online catalog of the current classroom-based teacher training courses is available at two Web addresses: http://www.ict.org/fall99/teachertrain.htm and

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http://www.ucsc-extension.edu/enroll_your_mind/education/teched.html

3. Development of Online Technology Training for Teachers

Efforts to offer classroom-based teacher training to an ever-increasing number of teachers became circumscribed by geographic limitations and marketing considerations. Increasingly, students/teachers couldn't commit to a standard schedule of courses or enroll in traditional classroom-based courses at a specific site. Beginning in early 1998, ICT decided to extend the scope and delivery of teacher training to under-served segments of the adult education market by developing online courses as an additional component of the Technology in Education certificate program. ICT partnered with Kaleidoscope Software, an online educational service with expertise in web-delivered instructional design, and an international corporation committed to global education. Online training would utilize state-of-the-art Web technology from the corporate world, expand the opportunities provided by the teacher training program, allow students to mix and match classroom and online courses, and refresh curriculum content.

Beta testing of a pilot course (one of the required, existing classroom-based courses) was determined to be the best means to understand the different needs of online learners, transform classroom instruction to a distance-learning format, set parameters and standards for future courses, and create a template. It was determined that each self-paced course would remain instructor-led, cross-platform transparent (when possible), and feature the same content as the classroom courses. Online course units and fees would be consistent with the classroom courses.

4. Results of Technology Training Pilot Course

As a result of the pilot course, it was found that time was a critical component - the teacher in fact spent more time with individuals in an online format and the time management of student e-mail became a major issue. Additionally, there needed to be a better means for interactivity between class members. Although it was important for the class instructor to be an experienced teacher, more often they would function as a facilitator and manager of learning, rather than as the fount of knowledge. Obstacles to be overcome included student's frustrations with technology and difficulties with coordinating synchronized chat rooms. Online learning also required the development of new paradigms: the length of the course, student response time, lesson re-purposing, and the challenging coordination of inter-relations between partners with differing 'cultural' orientations. A team approach was required for online course development, involving such diverse roles as an online manager, instructional designer, online instructor, and course author.

5. Further Online Course Development

The results of the pilot course were analyzed and taken into account for future course development. Specific hardware and software requirements were to be kept to a minimum level. Online students would be required to have basic prerequisite technology skills. The content was made truly 'anytime, anywhere' without required chat times - this made the learning a more global experience. Curriculum content was revised to follow a simplified, instructionally sound modular template - a pattern or design model to be utilized for all future classes. Links to subject-related Web sites supplied some of the course content for the self-paced materials, and hands-on activities/exercises and assignments provided the avenues for students to communicate with the teacher and each other. Instructor-led interactivity would remain at the forefront. Two means of asynchronous class communication were provided to every online student: a Virtual Classroom environment with a threaded bulletin-board message system, and Web-based email (offered to students if requested). A customized assignment calendar, an electronic self-assessment of computer skills and class evaluation form were also developed. Advanced administrative functions included grade retrieval, online course editing, and overall course monitoring. Detailed responses from electronic evaluation data collected from student participants are available.

An online catalog of *current* online teacher training courses (with sample lessons) can be viewed at the following Web site: http://www.eduniverse.com/edu/ictcatalog.asp

National Library of Virtual Manipulatives for Elementary and Middle Level Mathematics

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Efforts to increase and expand the interoperability of web-based instructional tools are receiving increased emphasis from university faculty, commercial vendors, and public and private funding agencies. Few can argue the enormous potential for providing low cost, interactive manipulatives with associated curriculum and resource connections, in an easily accessible, open-ended format.

This paper describes initial development and dissemination efforts of a National Science Foundation funded project (ESI-9819107). The project establishes a library of uniquely interactive, web-based manipulatives or concept tutorials, mostly in the form of Java applets, to teach mathematics with a high degree of engagement. All materials created to date are freely available through the Internet (www.math.usu.edu/matti), creating a national resource from which teachers and students anywhere may draw to enrich their classroom experience.

A recent review of research located five dissertation studies and four research articles from 1989-1999 where computer software was used to simulate or model physical manipulatives. In three studies (Kieran, C & Hillel, J., 1990; Smith, J, 1995; Thompson, P., 1992), students using computer-simulated manipulatives experienced higher achievement than students using associated physical manipulatives or no manipulatives. In two studies (Ball, S., 1988; Terry, M., 1996), students using a combination of computer-simulated and physical manipulatives showed higher achievement than students using no manipulatives. The remaining four studies (Berlin, D. & White, A., 1986; Kim, S., 1993; Nute, N., 1997, Pleet, L., 1990) reported no statistically significant differences between students who used computer-simulated or physical manipulatives and those students who used no manipulatives.

Due to an insufficient amount of research and the variability of research characteristics, we concluded that findings from the research review were inadequate to establish a thorough understanding of the value of computer-simulated manipulatives. Variability associated with grade level, school type, prior experience with manipulatives and computers, sample size, dependent measures, study design, treatment length, and software design must be considered as researchers continue to investigate the value of computer-simulations in mathematics instruction.

The Java-based mathematical tools and editors are designed to increase conceptual understanding of mathematical content and to link these electronic tutorials to companion content instruction for parents and teachers. While appropriate use of good physical manipulatives has been shown to increase conceptual understanding, these 'virtual manipulatives' directly link iconic and symbolic notations, highlight important instructional aspects or features of individual manipulatives, provide links to related web-based resources, and have the potential to record user movements through stored procedures within each application. In addition, virtual manipulatives are very cost effective, versatile, and provide at least as much engagement as physical manipulatives.

Development of each manipulative and tutorial is a collaborative effort between a team of elementary classroom teachers, mathematics educators, mathematicians, and software programmers. Typically, team members use teacher resources to identify physical manipulatives and associated concepts appropriate for development into an electronic counterpart. Associated curricular activities are linked to specific standards proposed in the Draft Principles and Standards for School Mathematics (National Council of Teachers of Mathematics, 1999). Initial versions of the applets are placed on the webpage (www.math.usu.edu/matti) and comments are solicited from users and national consultants.

There are several technological issues that have had significant impact on the software development process. These issues include specification of minimum hardware and software capabilities. For now, we are requiring a monitor resolution of at least 800 x 600, Windows 9x or NT 4.0, and a browser that is fully Java 1.1 enabled (Internet Explorer 4.0 or Netscape 4.5). There have been several browser difficulties using Mac operating systems running internet security software designed to screen teacher and student access to Java-based programs. Currently, the newer browsers on Mac operating systems 8.1 or higher will run any of our Java applets. We are planning to release a significant subset of our library that will require only Java 1.0 functionality.

The AWT for Java 1.1 is limited with respect to graphical tools. We constructed our own buttons, sliders, and graph windows that focus on math functionality. We now have a code base that includes a library of classes specifically designed to construct graphical user interfaces for interactive mathematics.

Initial evaluation and research efforts have focused on analysis of instructional design features that enable applet users to increase their understanding of mathematics concepts and incorporate applet use in their math curriculum. Currently, researchers are conducting a quantitative investigation on the effects of using the Geoboard, Tangram, and Pentomino applets on geometric concept acquisition among students in grades six through eight.

References

Ball, S. (1988). Computers, concrete materials and teaching fractions. *School Science and Mathematics*, 88, 470-475.

Berlin, D. & White, A. (1986). Computer simulations and the transition from concrete manipulation of objects to abstract thinking in elementary school mathematics. *School Science and Mathematics*, 86, 468-479.

Kieran, C. & Hillel, J. (1990). It's tough when you have to make the triangles angle: Insights from a computer-based geometry environment. *Journal of Mathematical Behavior*, 9, 99-127.

Kim, S. (1993). The relative effectiveness of hands-on and computer-simulated manipulatives in teaching seriation, classification, geometric, and arithmetic concepts to kindergarten children. *Dissertation Abstracts International*, 54(09), 3319.

National Council of Teachers of Mathematics (1999). Principles and Standards for School Mathematics: Discussion Draft. Reston, Va.: The Council.

Nute, N. (1997). The impact of engagement activity and manipulatives presentation on intermediate mathematics achievement, time-on-task, learning efficiency, and attitude. *Dissertation Abstracts International*, 58(08), 2988.

Pleet, L.J. (1990). The effects of computer graphics and mira on acquisition of transformation geometry concepts and development of mental rotation skills in grade eight. *Dissertation Abstracts International*, 52(06), 2058.

Smith, J.P. (1995). The effects of a computer microworld on middle school students' use and understanding of integers. *Dissertation Abstracts International*, 56(09), 3492.

Thompson, P.W. (1992). Notations, conventions, and constraints: Contributions to effective uses of concrete materials in elementary mathematics. *Journal for Research in Mathematics Education*, 23, 123-147.

Terry, M.K. (1996). An investigation of differences in cognition when utilizing math manipulatives and math manipulative software. *Dissertation Abstracts International*, 56(07), 2650.

Definition and Evaluation of an Interaction Model for a Three-dimensional Interface

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Abstract
We have elaborated a new 3D virtual workspace for distant meetings. 2D/3D documents can be integrated. The interaction must be generic so that the users can manipulate all documents in the same way. From real-time computer graphics techniques and users'abilities in a 3D virtual environment, we have defined a model on interaction together with the spatial organisation of the workspace. We emphasize the interaction based on two-handed direct manipulation, the use of two 3D input devices, simple metaphors, suggestive visual cues. Three experimentation tested our model. The first concerned the structure of the visual field and motor performances. The results show the latter is influenced by the visual context. The second one studies what are the relevant perceptive hints to enhance the pointing task performance according to the kind of input device used. The results show that isotonic devices are superior and that shadows are helpful to guide the action. The last one investigates the effect of shape of the shadow. The results suggest that the shape shadow was processing as a action's affordance.

A 3D INTERACTION MODEL

We define navigation as changes in the user's point of view. Interaction refers to how the user acts in the scene: the user manipulates objects without changing his overall point of view of the scene. Navigation and interaction are intrinsically linked; in order to interact with the interface the user has to be able to move within the interface. Unfortunately, the existence of a third dimension creates new problems with positioning and with user orientation (Hinckley, 1994); these need to be dealt with in order to avoid disorienting the user. This is especially true for our interface, where the main objective is not to navigate within the interface, but rather to act on the interface. This entails designing a coordinate frame where navigation within a restricted space is adequate and easy. With an 3D isotonic input device (Zhai, 1998) like Ascension™ trackers, translation of the dominant hand's movement is immediately reflected in the interface by the pointer (figure 1). In a real life situation, users cannot go search for documents or tools without getting up from the table. With our room metaphor, the user does not have to navigate to find objects, he can select them directly with the pointer, it can be moved throughout the entire meeting room. Although the appropriate input device is available to the user he may still lose his pointer when moving around in the interface. There are several ways of dealing with this problem. First, pointer orientation is used to indicate any change in direction and to enhance the impression of movement. Secondly, we use shading effects and the pointer's shadow is projected onto the floor. This helps the user to perceive meeting room depth accurately and to get his bearings quickly and easily (Kersten, 1997).

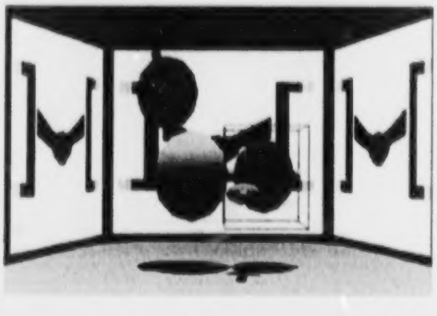

Figure 1: pointer on an H_2O molecule, with progressive bounding-boxes surrounding objects

Our model uses visual cues to show that an object has been selected or that it can be selected (figure 1): a graphical representation of a box appears progressively around the object. The closer the pointer is to the object, the more the surrounding box is visible and closer to the object. This progressive bounding box system greatly simplifies the manipulation of the pointer.

Once an object is selected, the user may want to manipulate it. In order to maintain direct manipulation and to avoid widgets, we use an isometric device, a 3D trackball, in the non-dominant hand to apply actions to the object (like rotation, etc.). So, our model uses bimanual interaction (Kabbash, 1994), because the user has more interaction possibilities and it simulates reality. It should reduce dominant hand movement and thus increase precision for object manipulation (with the isometric device).

EVALUATION

We show here the first experimentation but the poster will give the three experimentations that have tested our model at different levels of the conception. Recent developments for a 3D interactions showed that people had trouble in identifying the depth of a visual scene (Wanger & al, 1992; Carr & England, 1995) when using 3D input devices. The shadow enables users to infer both the position and the location of an object. The gap between an object and its shadow indicates the object's height above the ground plane. The location of a shadow on the ground plane indicates the object's distance. We hypothesize that shadow cues provided by objects and the dynamic shadow cues provide by the pointer influence the access to the depth and distance perception. They enhance the guidance for pointing an object in 3D scene and the pointing performance. The user is enabled to use static shadow and dynamic shadow information to guide actions, to achieve a particular goal and make decisions in a three-dimensional world.

The aim of this first experimentation was to analyse the effects of manipulating the contextual cues of depth on the accuracy of an aiming task. Expert and Novice subjects performed a pointing task in a three-dimensional environment. For this task, we used two kind of input devices : a combinaison mouse and keyboard, and isotonic device. The target was a cube presented in a 3D room. The 3D context is configured by three factors which are texture, dynamic shadow or no shadow to the pointer and static shadow or no shadow to the target. The pointer shadow is considered as the shadow follows the pointer moves. These three variables were allowed to build eight experimental conditions. The results have shown the superiority of using isotonic input device and the usefulness of the shadow for a guidance in a 3D computer environment.

CONCLUSION

Our interaction model is able to exploit the advantages of two sorts of devices (isotonic and isometric). We can manipulate easily 3D documents. We plan to further evaluate our model, especially with two-handed manipulation.

REFERENCES

Carr, K and England, (1995). Simulated and virtual realities. Elements of perception. Taylor & Francis.

Kersten, D., & Mamassian, P., & Knill, D.C. (1997). Moving cast shadows induce apparent motion in depth. *Perception*, 26, 171-192.

Hinckley, K., & Pausch, R., & Goble, J.C., & Kassel, N.F. (1994). A Survey of Design Issues in Spatial Input, *Proceedings of UIST'94*, 213-222.

Kabbash, P., Buxton, W. and Sellen, A. (1994). Two-Handed Input in a Compound Task., *Proceedings of CHI'94*, 417-423.

Wanger L R, Ferwerda J A, and Greenberg D P (1992) Perceiving spatial relationships in computer-generated images. *IEEE Computer Graphics & Applications*, 44-57.

Zhai S. (1998). User Performance in Relation to 3D Input Device Design. *ACM Computer Graphics*, **32**(4), ,50-54.

Modeling Effective Use of the Internet to Teacher Candidates

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Abstract: It is clear to all teacher educators that prospective teachers need to become prepared to implement technology into their classroom practices and teaching. The TEAMS (Teachers for Elementary and Middle School) Program is an undergraduate teacher preparation with integrated course work and field experiences. In addition, technology is woven as a strand in the program, with requirements integrated into all coursework. Our ultimate goal of integrating technology into the curriculum is to model best practices as we teach necessary knowledge and skills. This paper explores our first year's experiences in trying to implement these requirements and model technology integration into our teaching.

In Fall 1998, the University of Southern Maine (USM) admitted its first students in the Teachers for Elementary and Middle School (TEAMS) Program. TEAMS students are admitted as a cohort, a group of entering students who plan to pursue teaching in elementary or middle schools as a career, of no more than twenty-five candidates. This four and a half year program highlights field experiences each semester along with a seminar. Seminars include experienced educators from partner schools and from USM. Each semester the students take thematically based coursework in which class requirements connect course concepts to practices in the field settings.

Another unique feature of the program is the dedicated curriculum strands including: technology, art, multiculturalism, and literacy. Rather than requiring students to take just one or two courses in these areas, the program expectations span the four and a half years of the program. In addition, students are expected to not only know skills and concepts in these areas, but demonstrate their application in school settings. Aspects of the technology strand are the focus of this paper.

It is clear to all teacher educators that prospective teachers need to become prepared to implement technology into their classroom practices and teaching. In the development of the TEAMS Program, an Ad Hoc Technology Committee was formed which included faculty from the Teacher Education Department, The College of Arts and Sciences, the School of Technology, and three Professional Development School sites. This committee's work included: identifying the key technology knowledge base for prospective students in the program, identifying the method for delivering the technology training, and identifying the ways that this new knowledge could be extended into the Professional Development School sites. And, using the Internet is one aspect of this technology implementation that our teacher education program had to address. Below are the essential knowledge pieces from this committee's work related to Internet use:

> *Demonstrate skills using e-mail communication tools.* TEAMS students are required to participate in a Web Board conference and/or listserv during the program. TEAMS students must demonstrate their ability to ethically and appropriately participate in an electronic discussion group.
>
> *Demonstrate an ability to access and use the World Wide Web.* TEAMS students are required to use the Internet as a research tool for seminar sessions and bring the results of their searches for discussion. In addition, TEAMS students develop and maintain a TEAMS Program webpage. (http://www.usm.maine.edu/~karendd/teams/)

As the coordinator of this new undergraduate teacher certification program, I will share my experience in trying to implement the recommendations of the Technology Committee specific to the areas of Internet and web use.

In the first semester of the program, students began with learning the basic skills of using e-mail, accessing website information, and participating on a class listserv. This listserv proved to be an effective way for the students to communicate with each and discuss important issues and experiences outside of class discussions. The TEAMS students primarily used the listserv as a way of communicating information to each other and supporting each other.

But, in some cases it provided a forum in which students could reflect on experiences in their field. At the end of the semester, we agreed as a group, that we should continue to use some form of electronic discussion group in order to stay connected outside of class meetings. While the students felt that the listserv provided a valuable vehicle for debriefing, reflecting and discussing critical issues in education, we decided that using Web Board conferencing would better allow us to see the connection between on-going conversations without overwhelming students' e-mail. In addition, the Web Board will provide a better visual organization of messages by topic/theme.

Once students became proficient in those areas, they then worked as a team to develop a website for the TEAMS Program. Because some students had more experience developing websites than others and because we were approaching the task as a group, this process was a bit complicated. First, we needed to decide as a group what would be included on the webpage. Then we had to learn the skills to develop the webpage. And, finally we had to decide how we would break up the tasks so that the students could work in pairs on different aspects of the webpage. Overall, the process took approximately three weeks. And, the finished product needed major polishing. In developing the webpage, some students seemed more concerned with the content than the visual affect while others were more concerned with how the webpage looked than what it contained. So, the pairs were each assigned a two week period in which they continued to "clean up" the webpage and make any necessary revisions/additions. We continue to work on the webpage, always updating our work, and applying our deeper level of sophistication about developing webpages and adding new information about the program.

Since our ultimate goal of integrating technology into the curriculum is to model best practices as we teach necessary knowledge and skills, utilizing the Internet in a variety of ways becomes necessary. During this second year in the program we have decided to use two anchoring Internet resources in order to "force" students to learn how to use the Internet as a teaching tool: 1) all course materials have been put up on the web using CourseInfo and 2) students will participate in an electronic discussion using a Web Board Conference. Using these two resources will provide students in the program an opportunity to have greater exposure to the Internet as a learning tool as well as require them to use the resources available on Internet for their learning. These Internet tools allow me, as the instructor, to better incorporate using the web as a research tool as well. The students have a forum for which they can share the results of their Internet searches, commenting and responding to each other's findings.

Through this journey, I have learned a great deal about how to use technology as well as how to implement it into my own teaching practices. First, I have learned that many of my students know much more than I do about the using the Internet. Since I am supposed to be modeling for my students how to effectively use the Internet in a teaching situation, this creates some dilemmas for me. But, in reflecting on the discomfort I felt at times, it became apparent to me that it is more important that I continue to model ways to implement technology rather than be so concerned about whether I know as much about as my students. Second, I am becoming more aware of how important it is to have a background in teaching/curriculum as I work to integrate new technologies into my courses. Learning the technology is only part of the battle. Once I have learned the technology I need to consider in what ways will it be incorporated into and change the way I teach. In this way, I must give my teacher candidates the opportunity to learn the technologies, but also learn how to make it a part of their teaching in the classroom. Third, I am becoming more aware of how critical it is to reflect and debrief with my teacher candidates about the teaching decisions I am making about integrating technology. The true "teachable moments" happen when we spend time as a group thinking about what we did, how it worked and what can we learn that will make our learning more meaningful.

Ultimately integrating technology is just as a much a teaching issue as it is a technology issue. It is true that you need to know the technology in order to use it, but it is also true that if you know the technology but not how to integrate it, then it has no meaning. The focus of technology integration for teacher candidates lies in the modeling of strategies as well as an opportunity to try.

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Creating Optimized Learning Environments II: Pedagogy and an Interactive Web Interface

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Abstract: Students in the course described in this paper are active participants in their learning rather than passive recipients. They are given opportunities to learn via the following Web-based functions: (a) an interactive syllabus; (b) a series of Web Quests prepared by the instructor on course topics, including the instructor's Power Point presentations with notes and Web links embedded; (c) a threaded discussion group; (d) a private electronic journal; (e) web sites particular to the course linked from the course home page, including a publisher provided textbook Web page; (f) an interactive, dynamic, and organized set of Web links arranged according to content area of emphasis, to which students can suggest additions; (g) a large number of archived Web quests that students in former sections of the course have designed for their own and others' use; and (h) a form for submitting questions to the instructor.

1. Introduction

Potential educational opportunities and pedagogical flexibility that are available in Web-Centered instruction provided the impetus for the revision of a graduate course that has been taught for over 26 years. In the belief that the most appropriate role of a professor is to help students complete activities designed to enhance their learning, the role of the professor in this course changed dramatically as the potential of the web was brought into play. Gone forever is the "jug to mug" model of lecture, listen, and test. The efficiency given by technology now allows a different professor to student relationship. The constructivist approach of moving students from passive recipients to active designers of their own systems of learning coincides directly with the "learning to read – reading to learn" theme that guides the "Content Area Reading" course

2. Course Components

2.1 The Syllabus

The syllabus of "Content Area Reading" explains the requirements and contents of the course, and provides several Web links. Within the syllabus students also find a link that allows them to create a profile of themselves, and thus to "register" themselves for the interactive elements of the course. Once they do this, they can participate in the course discussion and electronic journal features of the course.

2.2 The Discussion Group

The discussion group is an online threaded discussion in which all students participate. Though the professor does not usually contribute to this, he is able to monitor the discussion and respond to individuals or the group via the discussion or in class. Students choose the topics of their discussion. As a starter for the semester, each student is asked to make a first entry on the topic, "Why I am taking this course." From that point onward, the discussion meanders as most discussions do, taking on a life of its own.

2.3 The Journals

Students are required to make entries to their journals once or twice a week. They are instructed to use the journal as a record of reflections and reactions to the course that only they and the professor can access. When a student posts an entry, the professor receives an automatically generated e-mail message that notifies him of the post. Within 24 hours, he opens the student's journal, reads the latest post, and replies via the email note. This ensures a continuous flow of feedback and response between professor and student. The final journal entry for each student is a required self-evaluation in terms of the individual's goals in taking the course.

2.4 Course Websites

An index of course Web sites, including a) the web site for the textbook, b) Kathy Schrock's home page, and c) a locally maintained site called The Content Literacy Information Coalition (CLIC), with hundreds of content-specific, on-line resources, as well as professional organizations, journal articles, and various other instructional artifacts. The latter is a site that allows students and other users to add resources as they find them and wish to share with others.

2.5 Class Notes

These notes are given as a series of Web Quests prepared by the instructor on course topics, or the instructor's Power Point presentations saved in HTML format, including notes on each slide. Slides often contain hypertext links related to the topic and links to electronic reserves placed on line by the instructor. The class meets in a computer lab where at the beginning of each class session, students access the course Web page, turn to class notes, and open the notes for the day. They then use a process of think, pair, and share to think about each Web Quest or slide/notes combination. They pair up with a partner to compare their own notes about the information presented and then share that information with the class. The class discussion centers on the questions and comments of the students in response to the notes.

2.6 Web Quests

Web quests are created by the students based on the model and template provided by Bernie Dodge (the creator of Web Quests). Each student creates a professional web quest for teachers and a student web quest on a topic of their own choice for classroom use. These are posted on the class Web page as they are completed, usually near the end of the semester, and each semester's work is archived and accessible for later use.

3.0 Support and Maintenance Issues

Issues of access, expertise, availability, and ease-of-use are still common and serve as barriers to some students and faculty. The current course is run on locally generated perl scripts so maintenance is high and changes are approached gingerly. The current Web structure has worked well for over four years. However, difficulty in making changes to the course and modifying basic structure of the course is a task that is both time consuming and expertise intense. Efforts have been started to produce a course Web structure that will be both flexible and easy to maintain. A number of options are under test, including selected commercial products and a locally generated course authoring and maintenance system.

Identification of the critical pedagogical issues in using the Web in graduate education has a direct bearing of the type of software that can be used to ease the burden on the instructor for development and maintenance of a course. Experience gleaned in the attempts to modify the structure of this Web course will be shared and suggestions for better solutions will be sought.

4.0 References

Vacca, R. T. & Vacca, J. L. (1999). *Content Area Reading: Literacy and Learning Across the Curriculum (6th edition).* New York: Longman

Management techniques and software quality for small scale Web project developers.

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Abstract: Computer project management techniques that are taught to information technology students concentrate on the theory and practice of information systems development (the traditional systems development cycle and object-oriented modelling techniques), as well as on the industrial project management techniques, common to most organisations [Bennatan, 1995; Ince, 1995]. However information technology students (undergraduate or postgraduate) are faced with developing projects in their course, on a much smaller scale, requiring abridged management techniques. Many information technology students are normally involved with small scale project teams of 2 or 3 students. In many cases, students are required to develop computer software projects alone. Students often find it difficult to translate the theories of computer project management into practice and require a practical set of activities which demonstrate the principles of larger system development, but at the same time, allows for effective understanding and application of sound computer management techniques on a smaller scale.

1 Introduction

The most common form of small scale computer project management, used by information technology students is Web site development, as the technical environment is easy to develop and popular with all organisations. As a project manager, the computing professional is required to express the skill and knowledge acquired from all experiences in programming, systems development and object modelling. This paper examines how such skills and knowledge can be strategically adapted for Web site project design and management on a small scale by individuals or small group developers. One method of *user-centred design* [Abels, White & Hahn 1998] sets out to identify and implement user based criteria and developed a four stage process based upon the users' task related information seeking/Use behaviour. The alternative approach to user-centred design proposed by [Abels, White & Hahn 1998] consists of four traditional software engineering stages: information gathering, development, evaluation and implementation.

2 Forming the Web project management team

Before development, set up a *Web Project Design Studio* as a Web page where you can design and monitor the development of your Web project. Your new design studio (a metaWeb site!) can be linked from your other Web pages. The exact form and content is left to you, but it is a "*show and tell*" site where you can experiment with, and share with others, the Web publishing techniques to be used on your Web site. Here is a simple layout for such *a Design Studio*:

- a small resume and project description
- contact details and an e-mail link
- up-to-date information about your project using project management techniques
- a link to your developing Web site
- resource collection
- documentation of the project including User Guides and References Manuals if needed.
- prototyping - samples of your publishing skills
- "other" - these are sections and links to anything that you determine such as site evaluation forms.

The Web project management team is responsible for setting policy, allocating roles for team members, template construction for the Web site and the formation of sub groups. Formation of the Web site development team is usually part of a formal process for larger project development, but for small scale projects, some members of the team may be required to take on several roles, so care should be taken that regular communication is made and that the roles do not cause conflict. As an individual developer, at least one other person should be assigned the *quality assurance role*, while several other roles can be enlisted by the single developer. For small groups, all members form the *Web Project Management Team* [Charles Sturt University, 1998]. Two main sub-groups are required:

1.*Web development (devel) sub-group*, responsible for sourcing, editing and migration of Web site files to the quality assurance (*qa*) area.

2.*Web quality assurance (qa) sub-group*: responsible for quality assurance team tests and evaluation of all files according to the quality assurance policies and migration of successful files to the online production site.

The Web site files have three possible status codes: *devel*, *qa* and *prod*, as defined in [Tab. 1]. These file status codes are used to identify and track the development of the files within the Network Publishing System (NPS) in [Fig. 1].

Production area	**Characteristics of each production area**
Development *devel*	The development group of people, hardware, software and processes for sourcing and editing files. This can be on a local computer or offline Web server. The *devel* team can receive files for updating from the *qa* or the production site. All files sourced or existing as *qa* or *prod* files in this are are marked as *devel* files, before sending to the *qa* area.
Quality Assurance *qa*	The quality assurance group of people and procedures for testing, proofing and evaluating *devel* files. If *devel* file passes all tests, the file status is changed to *prod* and sent to the production Web site. If a *devel* file fails a test, its status is changed to *qa* and sent ba to the *devel* team.
Production ***prod***	This is the main Web site and server area where the final product resides. Only files from the *qa* area can received, but files can be sent to the *devel* area for updating.

Table 1: Status codes for files flowing through the Web publishing production areas of the NPS

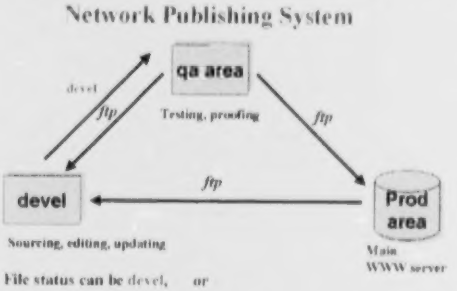
Network Publishing System
qa area
Testing, proofing
devel
ftp
ftp
ftp
devel
Sourcing, editing, updating
Prod area
Main WWW server
File status can be devel, or

Figure 1: The Network Publishing System (NPS).

The Web site management team should decide all issues concerning the context, technical environment, communications (via meetings and e-mail) and template construction, before dividing up into sub-groups. On the smallest scale, a Web developer must have at least one other person to act in the *qa* area, as only the *qa* area can send approved files to the production Web site. If however, you are still working alone, you must "*swap roles*" and still function in the *qa* area, perform the tests and proofing activities, before sending the file to the production site. Using a colleague to help with a peer review *qa* process, however is a better option than trying to do it alone. Web system development can be broken down into a version with eight steps for system development and testing of small scale Web projects. The activities in each step are used to help focus ideas and to track the project using project management tools and techniques as described by [McLeod & Smith 1996] and [Gido & Clements 1999].

Conclusion

Management techniques for small scale Web projects, contain many of the features of object modelling and the systems development life cycle for students to employ. The skills and knowledge constructed from previous studies are used to development the student's own project management style. User-centred design methods, as shown by the Silo case study, assist with the evolving conceptual design of a Web site and the work in [De Troyer & Leune 1998] provides a Web site design method (WDSM) that supports the inclusion of object modelling techniques and the description of user classes. Setting up a *Web Project Design Studio* as a Web page where you can design and monitor the development of your Web project is essential.

The Web site development team structure for larger projects can be harnessed to fit the needs of a smaller team. Suggested strategies for small teams included dealing with issues such as multiple roles and reduction of conflict by regular communication. For an individual developer at least one other person should be assigned the quality assurance role as the best option or as a fallback option, several roles can be enlisted by the single developer by "*swapping roles*". The Network Publishing Model in [Fig. 1] further extended management techniques by providing a simple structure and labelling of sections and assigning file status codes as *devel*, *qa* and *prod* to support quality production of Web site files by small teams.

References

Abels, E. G., White, M.D. and Hahn, K. (1998). A user based design process for Web sites. *Internet Research: Electronic Networking Applications and Policy*, Vol. 8, No. 1, pp39-48, MCB University Press.

Bennatan, E. M. (1995). *Software project management: A practitioner's approach*. 2nd edn. McGraw-Hill, London.

Charles Sturt University. (1998). *Charles Sturt University Web Policy*. [Online]. Available at http://www.csu.edu.au/acadman/webpolicy/wp98.htm.

De Troyer, O. M. F. and Leune, C. J. (1998). WSDM: a user centred design method for WEB sites. *Proceedings of WWW7 Conference*, April 14-18, Brisbane,Australia.

Eustace, K. and Fellows, G. (1999). Online information needs of farmers: a longitudinal study. *ISPG research* [Online]. Available at http://www.csu.edu.au/research/ispg/papers/infofarm.html

Gido, J. and Clements, J.P. (1999). *Successful project man*agement. South-Western College Publishing, Cincinnati, Ohio, USA.

Ince, D. (1995). *Software quality assurance: A student introduction*. McGraw-Hill, London.

McLeod, G. and Smith, D. (1996). *Managing information technology projects*. Course technology ITP. Cambridge, MA.

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Applying a New Model: Moving a Course from the Classroom to the Web via the SUNY Learning Network

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Abstract: During the Fall of 1998, a new course designed for Communications majors was offered on campus. It provided an introduction to information technology including the Internet, web page creation, desktop publishing, and computer graphics. This course was a success as evidenced by student comments and grades earned. The challenge for the Spring 1999 semester was to offer it in an asynchronous format using Lotus Notes via the SUNY Learning Network with similar results. This short paper will compare and contrast both methods of delivery. Student success and satisfaction data as well as improvements to the online course planned for Fall 1999 will be shared.

Traditional Model

A text, *Information Technology: The Breaking Wave*, was selected. A companion CD containing multimedia presentations supplemented the text. The students met 3 hours a week for fifteen weeks in a computer lab. They had access to the lab during hours when classes were not in session. Students used IBM PCs, a SONY Digital Camera and Scanner, and an HP Color Scanner. They also had a computer account with 40 MB of space and access to ZIP drives for storage. Students kept abreast of recent advances in technology through research in newspapers, magazines, and on the Internet.

The software packages available including Microsoft Office 97, Netscape Communicator 4, Internet Explorer 4, PageMaker 6.5, PhotoShop 5, Illustrator 7, and PageMill 3. An electronic mailing list was created for the class, and the instructor used it to communicate with the members of the class at least once a week. Students used the mailing list to communicate with each other. A companion web site was created for the course, and materials such as the course syllabus and instructions for completing class projects were posted.

Students worked individually or in teams to create their final project, a web site, which was stored in their own computer accounts or at a free web-hosting site. The projects were demonstrated during the final class, so all students had the opportunity to view each other's work. In addition to submitting their project for a grade, two groups of four students linked together the web sites they created for the Communications Club and the Communications Department and entered a contest for the best student-created web site on campus. They won first prize, $500, to be used for a Communications Club field trip.

A New Model

The next question was, "Could this course be delivered online with similar results?" A decision was made to offer the course online through the SUNY Learning Network for the Spring semester. The same instructor, this author, attended three one-day training sessions, received a course template, and developed the course using Lotus Notes. The same textbook and companion CD were used. Based upon student feedback from the first course, a second CD that introduced the concepts of the Internet and taught students how to create a simple web page using the Hypertext Markup Language became an added requirement.

Lotus Notes provided a course map, which allowed the instructor to post modules containing lectures, written exercises, activities, and discussion threads. The lectures provided hotlinks to web sites containing information to supplement the textbook. An area for students to "Meet their Classmates" was used, as was a Bulletin Board for posting messages. The instructor communicated with individual students regarding issues not related to their coursework through an email account provided by SLN. Students were instructed to read the chapters in the textbook, complete all of the assignments, review the chapters by completing the practice quizzes on the companion CD, and demonstrate mastery of each chapter by completing an online objective quiz.

Instructions were posted for students to complete assignments using Microsoft Office 97, which was the software package identified in the course requirements. However, not all students had that software on their systems. The instructor, therefore, obtained copies of almost all of the software used by the students and spent many extra hours providing individual assistance to those students.

Students were required to post their final project on the server provided by their Internet Service Provider or at a free site. Again, individual assistance was necessary. The projects were graded. The URLs of all sites were made available to students so that they could see what their colleagues had accomplished.

Student Success Rates/Satisfaction with Course

Nineteen students registered for the traditional course but one withdrew; the remaining eighteen students satisfactorily completed the course. Seventeen students registered for the online course the following semester, but one of those did not complete the course and received an F. The following table shows a comparison of the letter grades earned.

Traditional Course taught on campus Fall 1998			Online course taught via SLN Spring 1999		
Grade	# of Students	% of Students	Grade	# of Students	% of Students
A	10	55.6%	A	13	76.4%
A-	1	5.6%	A-	2	11.8%
B+	0	0.0%	B+	1	5.9%
B	3	16.7%	B	0	0.0%
B-	2	11.1%	B-	0	0.0%
C+	2	11.1%	C+	0	0.0%
F	0	0.0%	F	1	5.9%
Totals	18	100.0%	Totals	17	100.0%

Table 1: Comparison of grades earned Fall 1998 and Spring 1999

The same satisfaction survey was provided to students each semester. Student taking the course on campus appreciated the fact that the skills they obtained were "useful" and they were now "computer literate." Several students simply said, "Thanks a lot!" and "Enjoyed this class." One student appreciated the fact that the instructor "smiled a lot." Although the students in the online course couldn't "see" the instructor, similar comments were noted including: "Excellent class and teacher," "Questions were answered quickly," "Learned a lot," "Great course," "Great Job."

It was apparent that students appreciated the course because the skills and knowledge they gained were "relevant" and the instructor provided a great deal of individual attention regardless of method of delivery. This course, whether taught on campus or online, was a success!

Improvements for Fall 1999

The requirement to use Microsoft Office 97 will be enforced, and more detailed instructions for assignments requiring the use of computer software will be provided. In addition, activities providing the opportunity for teamwork will be explored.

Fast Start for Web Accessibility

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Abstract. The Internet is revolutionizing business, education, and healthcare due to the explosion of technology for worldwide communication. In the USA, one person in 10 has a severe disability. (Microsoft, 1999). USA law requires federally supported agencies and programs to develop Web sites accessible for physically challenged individuals. Even if not required by law, smart business will want expand their consumer base. "Computers and cyberspace are far from the exclusive province of younger generations. Based on research, the fastest growing demographic group using high tech and the information highway is mature adults, age 50-75." (Hansen, 1999). Many seniors will not need any special assistance; however, there are selected accommodations such as size of type, which will enhance the electronic experience. The Fast Start Guide helps to address this issue now by adding alternative text links to current sites to obtain "Bobby approved" recognition, (which is the standard indicating universal accessibility). Over 3 million web pages are tested per month, and only 650 sites have been approved. (Cast, 1999)

Introduction

The FAST START Guide to be published by the Institute for Quality Improvement in Long Term Health Care is being developed to enable quick conversions of complex web sites to accessible "text only" sites using any popular "What you see…is…What you get" web page composer. There are also several immediate effects of transforming complex web sites with beautiful graphics and **wonderful eye candy to primarily text-based web sites**. The download time is faster. The loss of eye candy does not effect the information conveyed. When pictures or images are needed, a clear description of that image provide the same effect for the viewer as reading a book. ***The FAST START Guide*** avoids the use of tables, without the loss of information.

More information about Fast Start can be found at the Internet site.
http://www.swt.edu/~df12/Fast/OVERVIEW.HTM

Selected Key Players

The World Wide Web Consortium (W3C), was created to lead the Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability among different types of computers. This international industry consortium is run jointly by the MIT Laboratory for Computer Science (MIT LCS) in the USA, the National Institute for Research in Computer Science and Control (INRIA) in France, and Keio University in Japan. The guidelines developed as part of the W3C Initiative program are a model for HTML programmers to develop accessible sites based on a series of priorities. W3C is to be applauded for their leadership role; however, many individuals want Bobby approved sites without having to learn HTML coding. Information about the W3C

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can be found at:
http://www.w3.org/Consortium/

Another organization, the **Center for Applied Special Technology, (CAST)** is an educational, not-for-profit organization, which uses technology to expand Internet opportunities for all people, including those with disabilities. In addition it includes assistance for obtaining Bobby Approval (a software program from CAST, which determines if a web page is disability accessible). Over 3 million web pages are tested per month, and only 650 sites have been approved. "CAST is committed to providing Bobby as a free public service in order to benefit the greatest number of people throughout the world." (Cast, 1999)

Overall Conclusion

The use of the Internet can provide an effective source of information for all business, education and healthcare organizations. The Fast Start Guide allows very quick "what you see…is what you get" transformation of complex sites to Bobby approved sites (the standard of measurement to indicate universal accessibility). The guide should help you obtain approval within one to three tries. All of the sites, which we have personally transformed, that were not approved the first time, did obtain approval after the second try. Examples of complex sites with alternative text sites that have earned Bobby approved status include:
Deanie French home page: http://147.26.105.119/hsr/homep.htm

Web Design, Development and Evaluation: http://www.swt.edu/~df12/Internet/right.htm

References

CAST. (1999). What's New. [On-line]
http://www.cast.org/bobby/news.html

French, D., Bett, S., Farr, G., & Hooks, L. Chapter Five, Augmenting Traditional Teaching with Internet Based options Internet Based Learning: An Introduction and A Framework for Higher Education and Industry. (Stylus Publishing, Inc, 1999).

Hansen, Leonard. (1999). Computer, Internet Opportunities Increase for Mature Adults. [On-line]
Http://microsoft.com/seniors/content/pr99/hansen_article.asp

Hiltz, R.S. (1995). Teaching in a Virtual Classroom. International Conference on Computer Assisted Instruction [On-line]. Available: http://www.njit.edu/njIT/Department/CCCC/VC/Papers/Teaching.html

McClintock, R., & Taipale, K. (1997). Computer-Mediated Communication [On-line].
http://www.ilt.columbia.edu/academic/classes/TU5020/Tu5020sy.html

Microsoft. (1999). How Many People Have Disabilities? [On-line]. Available at:
Http://www.microsoft.com/enable/microsoft/people.htm

Powell III, Adam Clayton (1999.) New Law Requires Web Sites to Become 'handicapped accessible'. [On-line]. Available at:
Http://www.freedomforum.org/technology/1999/4/30handicapaccess.asp

Reid, K. (1996). Impact of Technology on Learning Effectiveness [On-line]. Available:
http://lucent.com/ced1/impact.htm

Developing Standards-based "Technology Intensive" Courses

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AbstractA systematic process was used for developing a new designation of "technology intensive" courses including course standards and guidelines. The standards include six categories based on: ethics, operations, analysis, retrieval, application, and attitudes. Among the categories are there 33 specific standards. Faculty in the project have been provided with ongoing professional development to effectively integrate technology into their courses. Most sessions provided faculty with hands-on practice with the technology. In a three-year project 35 courses in a variety of disciplines were developed.

Purpose

Technology is already an integral part of modern life and increasingly demands are being placed on educational institutions to prepare students to live in this high tech world. Vast resources of information are available. As future workers, students will need to have the skills to access and manage these resources, ask pertinent questions, and draw logical conclusions. Technology offers a wider variety of learning and communication styles than traditional education and allows students to use tools relevant to the workplace.

The purpose of the project was to develop a general designation of "technology intensive" courses that could be used university-wide. "Writing intensive" courses were used as a model for development for the project. Three grants over a three-year period have been received for this effort. Each project had two major components: faculty professional development and course development.

Technology Intensive Standards

The type of impact desired called for an expansive, long-term project thinking through "what should our graduates know?" A committee of 16 faculty members from a broad range of subject areas in 14 departments met to develop a set of "technology intensive" standards and guidelines for the development of the courses. The standards include six categories based on: ethics, operations, analysis, retrieval, application, and attitudes. Among the categories are there 33 specific standards.

Technology Intensive Guidelines

The following excerpts are from the technology intensive guidelines that provide information for faculty on course development.

> The course subject matter should remain the priority for technology intensive courses. The technology should help facilitate communication, problem solving, analysis, research, and presentation. It is highly recommended that faculty planning technology intensive courses develop curriculum that utilizes at least one standard from each category. No single course can cover all of these standards. The idea is that among the variety of courses students take, they will upon graduation have mastered these standards.
>
> Technology intensive instructors should serve as exemplary role models for the use of technology. ... Instructors should model good ethical standards when using technology, such as, adhering to copyright laws. Good instructional and visual design are fundamental to learning with technology.
>
> Technology intensive courses must have the essential component of student involvement. Students not only need to see technology used by a good role model; they need to use it themselves. ... Students should have opportunities to create course projects that include technologies such as multi-media, web pages, videos, and electronic slide-shows. ...

Discussing the use of technology frankly with the students is highly recommended. It is expected that the instructors will need to acknowledge issues of access, skill level, and anxiety. Helping students understand the need for growth in the area of technology is an important part of the process.

Course Development

Faculty in the project have been provided with ongoing professional development to effectively integrate technology into their courses. Most sessions provided faculty with hands-on practice with the technology. Faculty professional development has included topics such as: course design, visual design, electronic conferences, web page design, multi-media and video production, electronic presentations, technology ethics and copyright, assessment of technology projects, one computer classroom strategies, and the use of and science probe software. Each course developed during this project needed to undergo considerable curriculum restructuring to meet the standards for technology intensive courses. Faculty had to reevaluate their teaching methods so that they demonstrate effective technology use. Thirty-five "technology intensive" course have been or are being developed. These are some of the courses.

Japanese 202: Intermediate Japanese, is supported by multimedia technology. Students experience real-life communications with students in Japan through email and enjoy first-hand information on the Web. Students learn to use essential software and, the video camera and editor for class projects.

Speech 251: Principles of Effective Speaking, models technology by using electronic slide presentations, pictures from digital cameras, and electronic mail. Students use a variety of technologies to search for and present information. They videotape their speeches to evaluate their performance. To respond to guidelines on ethics, students spend one full day in class discussing ethical issues in public speaking.

Botany 456: Plant-Animal Interactions has a class web page that includes the syllabus, assignments, practice exam quizzes and links to other sites relating to lecture topics. All class lectures are delivered with presentation software to allow for seamless incorporation of sound, color photos, and video into lectures. Students participate in and lead online discussions and use a graphical software package to simulate interactions between plants and herbivores over space and time.

Family Resources 230: Human Development students use multimedia to learn about human development over a lifespan. They use the course web site to participate in chat room exchanges and conduct searches. Students have the opportunity to practice with computerized self-exams and then take computerized tests.

Math 206L, students use calculus software for computing and graphing in order to understand course concepts better. They use computer graphics to interpret problems and make approximations. The algebra features allow them compute exact solutions that then can be compared with the graphical approach. Modeling physical systems using both graphics and exact formulas will be done in the context of population growth and other differential equations.

Arts & Sciences 101/102 students are involved in an international project on the Internet called collaboratory, a theme-based research project. This project is a partnership among universities, schools, museums and corporations worldwide. They work on collaborative projects, share these with students around the world who are part of this initiative, and display their work locally at the end of the year.

Teacher Education and Curriculum Studies 439: Office and Marketing Technology. This course provides vocational education preservice teachers with an understanding of technology's impact on curricula and its use as a teaching tool in preparing youngsters for the highly technological workplace of the 21st century. Preservice teachers have the opportunity to explore and experiment with various technologies available in the classroom and in business and industry. They use desktop publishing to create brochures, newsletters, signs, and multimedia software to create electronic research papers.

Didactic Model of Internet Application in Education

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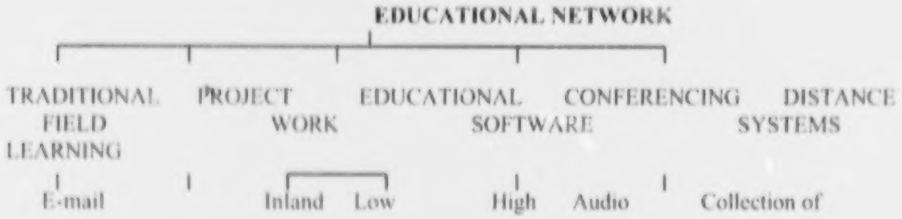
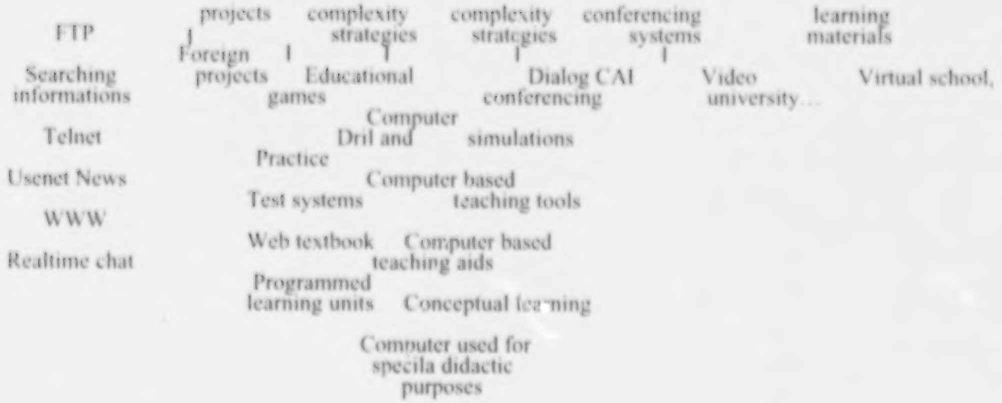
Abstract: This paper reports how the Faculty of Education – University of Maribor and Board of Education Slovenia is infusing technology into its education courses, in order that its students will be better prepared to use modern informatic technology in the schools.

In modelling computer application in the Slovene educational system, we proceed from the definitions of computer application, various Slovene and foreign authors have put forward in their works; yet, we basically proceed from the actual position and actual possibilities offered within the Slovene educational system. Among the points that concern the definition of computer's function and role in education, we considered those where the authors stuck to the *informal determination* (of computer's function and role in education); the authors show differences in the number of these possibilities of computer application they deal with, what naturally results in differences among these authors in the level of generalisation of individual possibilities. In our model, we distinguish globally among the following three fields of computer application in education:

- The *primary field*, - the field of computer science education; it comprises activities the aim of which is to make the participants in the educational process (the students), as future users of computers, familiar with the functioning and the use of computers (the field of general education), or to make them enthusiastic about work with computers, so that they decide for a professional career dealing with computers (special professional field).
- The *secondary field*, - the field of computer application in the educational process; here belong all the activities that are closely related to the frontal (direct) educational process in any subject area in elementary schools. In this case the computer serves as a teaching tool or aid in the traditional forms of computer-assisted learning systems (monomedia- or multimedia systems) on one hand, or in the systems supported by artificial intelligence (AI), - the so called expert learning systems.
- The *tertiary field*, - the field of activities that accompany the educational process; here belong various research activities, as well as school administration and management of the educational system, the latter thus being integrated into the educational informational system at the school, communal, regional, and state level, or at the international co-operation level.

The education benefits mostly from the *secondary field*; here belong the use of computer in e.g. teaching mathematics, physics, Slovene, science, sociology, music, etc. In all these cases computer serves as a teaching aid or tool, which is fully or partially involved in the teaching and learning course. If computer is fully involved, this means that it is part of every single phase of the teaching and learning process and that it interferes with the entire regulative teaching course, and that it is actively involved in all procedures - students' preparation for educational work, learning and work with new learning contents, practice, revision, checking what and how the students have learned in order to ascertain their knowledge and plan further work, etc. In the second case, computer is part of only some of the phases of the teaching and learning process (course), such as practice, revision, checking the

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conferencing systems
learning materials
FTP
Foreign projects
Searching informations
Educational games
Dialog CAI conferencing
Video university…
Virtual school,
Telnet
Computer simulations
Dril and Practice
Usenet News
Computer based teaching tools
Test systems
WWW
Web textbook
Computer based teaching aids
Realtime chat
Programmed learning units
Conceptual learning
Computer used for specila didactic purposes

Figure 1: Didactic model of Internet – educational network application in education

students' knowledge, presentations of new learning contents in individual steps or in the form of whole activities as units, etc.

As we can see, *educational networks* are increasingly making their influence felt in the lessons in monomedia- as well as multimedia-based approach. The educational networks bear all the characteristics of monomedia and multimedia systems. In the year 1995 we established in Slovenia the Slovene Educational Network, where an increasing number of our schools have access through Internet and Intranet to various projects home and abroad. Figure 2 shows didactic model of Internet – educational network application in our educational system.

References

- Gerliè, I. (1991). *Osnove rcèunalništva v izobraževanju* . Pedagoška fakulteta Maribor, Maribor.
- Hebenstreit, J. (1986). *The Use of Informatics in Education: Present Situation, Trends and Perspectives.* UNESCO, Paris.
- Merrill P.F., Hammons K., Vincent B.R., Reynolds P.L., Christensen L., Tolman M.N. (1995). *Computers in Education.* Allyn and Bacon, Boston, London, Toronto, Sydny, Tokyo, Singapore.
- Ministrstvo za šolstvo in šport (1997). *Stanje raèunalniške pismenosti v slovenskem šolstvu.* Zavod RS za šolstvo, Ljubljana.
- Richard C. Forcier (1996). *The Computers as a Productivity Tool in Education.* Merrill, Englewood Cliff, New Jersey, Ohio.
- Roblyer M.D., Edwards J., Harviluk M.A. (1997). *Integrating Educational Technology into Teaching.* Merrill, Englewood Cliff, New Jersey, Ohio.

Web Sites Lost in Cyberspace: How to Ensure your Web Site is Found

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Abstract: A significant number of resources are expended on developing and maintaining University of Victoria web sites. As student recruitment initiatives become increasingly more competitive, the ability for potential students and associates to locate departmental, faculty and staff web sites becomes critical. The emphasis of developing a University Web presence began by "getting the site published" and progressed to improving the design and usability of the site. However, a critical question remained unanswered, "What initiatives can be implemented to assist potential students and associates find the information they seek on University web sites?" The focus of this paper details the design techniques and strategies that organizations can employ to help ensure their web site is found by people searching the Internet using the Web's free search services.

Finding Your Web Page on the Internet

The main purpose of creating a web page is to publish information on the Internet for others to read. Effective design techniques and strategies can be implemented to help ensure that search engines will find and improve the site ranking results of your web page when users search the Internet for information contained on your web site:

- Prepare Your Web Page with Appropriate HTML Tags
- Avoid Features that Hinder Search Engine Indexing
- Register your Web Page with Search Engines

Prepare Your Web Page with Appropriate HTML Tags

Summary Paragraph To optimize the ranking results of your web page by search engines, the content must be carefully and succinctly written. Search engines index and rank the text placed at the beginning of the page. Write short pages containing substantive content, choosing keywords and keyword phrases that reflect the content of the web page. Position the most discriminating keywords at the beginning of the web page and within HTML tags to improve the search engine's ranking of your web page.

HTML Title Tag The title is the most important element indexed by search engines and is the first line of information displayed by a search engine in the listing of pages found. The title must engage the viewer's interest and encourage the viewer to read the description, and the description should compel the viewer to click on the link that loads the web page. *<TITLE>Finding Web Pages using Search Engines</TITLE>*

HTML Comment Tag Search engines that do not recognize META tags often use the comment tag description in the listing of search engine results. *<!--Use the text from the META Description tag-->*

HTML ALT Tag Attribute Search engines will not index graphic images. Use the ALT attribute to provide a method for search engines to index the graphic image and provide a text description of what the image represents for browsers that do not display graphic images. *<IMG SRC="sengine.gif" ALT="Search Engine Indexing Chart">*

Descriptive URL Choose a descriptive URL when naming the web page. For example, in a document containing year 2000 information, the URL */y2000/y2kinfo.htm* will more likely be found and receive a higher rating from search engines than */web/info.htm*.

HTML META Tags Many search engines use META tags to index web pages and respond to a searcher's query. Their purpose is to provide information about a web page without the search engine scanning the entire document. The *description* element defines the summary that some search engines display after the web page has been selected by a keyword search. The description should be brief and describe what is found on the web page, as well as encourage the searcher to click on the link that loads the web page. The *keywords* element includes the carefully selected keywords that reflect the content of the web page. Specify keywords and keyword phrases you anticipate the user would choose, including common misspellings. Separate each keyword or phrase with a comma.

> *<META NAME="DESCRIPTION" CONTENT="Finding Web Pages using Search Engines. The main purpose of creating a Web page is to publish information on the Internet for others to read. What can you do to ensure search engines will find your web page when users search the Internet?">*

> *<META NAME="KEYWORDS" CONTENT="promoting web sites,finding web sites,finding pages,searching internet,web page promotion,promote your web site,marketing,finding sites,search engines,directories,promo, finding information,register,locate,web development,hits,internet,searching sites,marketing,marketing web sites,marketing web pages,increase hits,locating pages,submitting web sites,internet promotion">*

Avoid Features that Hinder Search Engine Indexing

Some design features will hinder the ability of search engines to index web pages. Without special consideration, search engines cannot index web pages that contain frames, image maps, Java and Perl scripts and CGI directories. The use of invisible or tiny text, pages with a high META fresh rate or words repeated excessively on a page will be recognized as *spamming* (falsely improving the ranking position of the page) and will not be indexed.

Register your Web Page with Search Engines

It is a good idea to register your web pages with search engines because non-submitted web pages may take several months to be indexed and not all search engines use robots to automatically find and index web pages. Unless you submit your key web pages with the popular search engines and directories, it is unlikely that search engines will find your web page. For best results, register web pages manually or use an automated submission service. Resubmit the web page if the original submission was not accepted. To prolong the listing of your web site in search engine databases, frequently update the content of your web page and the corresponding *last updated* date.

Manual Web Page Registration

Before registering web pages, determine how each search engine displays its found listings and read the Help pages to confirm your submission adheres to the criteria for each search engine. Search engine robots require the web page URL. Directories require more information such as the URL, title, description, subject category and keywords.

Automated Submission Services

Free submission services are available to automate web page registration. Some search engines will not accept registration by a submission service and registration may take much longer.

Free search engine submission service: *http://siteowner.linkexchange.com/*
Free search engine ranking service: *http://www.rankthis.com/*

References

Clay, B. (1999). *Search Engine Optimization Promotion Tools* [Online]. Available: http://www.bruceclay.com/ [1999, August 5].
Sullivan, D. (1999). *Webmaster's Guide To Search Engines* [Online]. Available:
http://searchenginewatch.com/webmasters/index.html [1999, August 16].
Visual Metrics Corporation (1999). *Tutorial: Guide to Effective Searching of the Internet* [Online]. Available:
http://www.thewebtools.com/tutorial/tutorial.htm [1999, August 16].
WDVL internet.com (1999). *How in the World (Wide Web) will they Find me?* [Online]. Available:
http://wdvl.internet.com/Location/Promotion/ [1999, August 12].

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The Integration of Web-based Learning with the "Real" Classroom: An Art Education Paradigm

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Abstract: The New Museum of Contemporary Art's *Visible Knowledge Program* Web site, based on cold fusion programming, is both dynamic and interactive. Complementing the Education department's outreach efforts to high school students, the site provides a forum for educators, artists, students and museum staff to share ideas, engage in dialogue and work towards "real" and Web-based projects in both the physical and online classrooms. As with any new concept for a traditional practice, there is need for continual revaluation and modification of the vision by its creators and participants.

The New Museum of Contemporary Art's Education department has been working with alternative high schools and at-risk students in the New York area since 1984 as part of the *Visible Knowledge Program* (VKP). Pairing artist-instructors with classroom teachers on a semester or year-long basis, the Education department provides professional development and technological support to VKP participants collaborating on the integration of contemporary art with core high school curricula (Social Studies, English, Science) and the development of online Classrooms and Studios. In liaison with museum staff, the teachers and artist-instructors develop and teach weekly lessons that explore the connections between contemporary art practice and current cultural and social issues introduced in the different subject areas. The program encourages critical thinking about these issues and various interpretations of art through a multicultural and interdisciplinary team-teaching approach. It also empowers student expression by drawing upon their diverse personal values and interests.

Launched in March 1999, the *Visible Knowledge Program* Web site (www.vkp.org) uses cold fusion programming to provide an interactive and continually expanding resource and work space for educators, artists and students. The site complements the practical in-class learning experience by providing a cyber learning environment consisting of four areas—Classrooms, Studios, Galleries and a Library. The Classroom and Studio spaces offer participants individual or group work areas to upload images of student and artists' work, personal statements and lesson plans in progress. Both the Curriculum Units, which may be downloaded, and the Classrooms are linked to Forums where visitors and registered users, who gain sign-in access by applying to the site administrator, may participate in dialogue and offer feedback on the lesson plans and posted work.

The eventual goal of the VKP Web site is to reach and support educators worldwide. As the site is still quite new, the activity online consists only of the teachers and students from the schools with which the museum has established collaborative programs. Even at that, the use of the site has been sporadic. The challenge the department now faces is how to fully incorporate the site into the classroom learning process and then extend it in an organic manner specific to each unique group of students. Measures have recently been taken to ensure that the site will be used more consistently, eventually drawing in participants from outside the core group of collaborating schools in the New York area.

The first step was to make inclusion and use of the VKP site and training with the site administrator mandatory for all teachers and artist-instructors who wish to participate in the program. Before the start of the school year, both artists and teachers are required to attend a training session with the site administrator in how to use the site and access and maintain the areas for which they are responsible: classrooms and studios. The museum has no binding contracts with the teachers, as it is the participating schools' responsibility to reimburse their teachers for time spent in professional development and training workshops. They are, however, still required to fulfill the expectations and adhere to the deadlines presented at the outset of the program. As for the artists with whom the museum does have contracts, there are very specific requirements that must be met as outlined in their agreements, like the monthly submission of lesson plans and updating of online classrooms.

In addition to training the adults, the site administrator also goes into the schools to do a training session with the students, provided the school is equipped with Internet access, on how to open and maintain their individual studios. If the school is not online, the students are encouraged to go to the museum, where the site administrator can work with them on the work stations in the education seminar room. High school interns are appointed from all the collaborating schools and act as liaisons between the museum and the "real" classroom. They will also be carefully trained on the Web site, so they may offer technical support to their class when the site administrator is unavailable to go out to the school.

Beyond technology training, the use of the Web site and its integration into the *Visible Knowledge Program* will be addressed at professional development meetings, of which there are twelve throughout the school year. Time has been scheduled for discussion among participants and museum staff about ways of including the site into the curricula and ideas for new media and Web-based projects. Of course, as with any addition to a class lesson, standards and measures of evaluation must be considered and employed to assess the technology-based work. Teachers will need to decide, with the help of artists and staff, how much of the class grade the technology and art aspects will constitute and how much class time will be devoted to these components.

After an initial lack of valuable responses in the Forum section of the site, the department's aim this year is to create a structure that facilitates more regular and evocative discussion in the Forums. In response to this need, time is being planned into the professional development meetings for teachers, artists and museum staff to engage in Forum discussions online and respond to comments and questions from browsers and other participants. It is also our hope that time will be allotted during the class period for students in one classroom to respond to feedback from students in another, so that there is continual dialogue among the youths as well. It will be interesting to see how teachers and students incorporate this feedback into the development and eventual outcome of the project. The use of the Web site will naturally emphasize the importance of process to both students and teachers, as they will have regular opportunity for reflection and revaluation of their choices and the directions in which their projects are going, especially in the Forums.

The education staff acknowledges that the long-term success of the Web site depends on this type of dedicated participation by all members of the program and its consequential benefit to the students. Taking this one step further, the department is working on creating incentive for the students to sustain participation on the site by having the school and/or teachers offer some type of class credit for their involvement. Independent of credit, however, the museum builds in its own incentive for teachers, artists and students by offering them a space to exhibit their work either at the museum or at an off site venue.

At the end of each collaboration (usually coinciding with the academic year), there is an exhibition of the students' final projects, which express an idea or concept resulting from what they learned through the intersection of contemporary art with the class subject. Sometimes a third component is added when the students' work is displayed in conjunction with an exhibition at the museum. From experience, this opportunity to display a work in a well-established art institution has been the most effective incentive yet.

After a full academic year with the Web site functioning and integrated into the VKP, the staff will be able to assess its effectiveness and future potential. For now, though, the long-range objective of the museum is to have an international network of educators using the site as a work space and sounding board for current museum and art education practices. The New Museum aims to promote replication of the *Visible Knowledge Program*, either in its existing form or in modified versions appropriate to particular learning institutions. To that end, the site strongly encourages open communication about the program, the lesson plans and the pedagogical philosophy of the Education department. With classroom teachers and museum educators worldwide participating in this dialogue, schools without art programs and museums with few educational resources will benefit from the fruits of the VKP's collaborative efforts.

Acknowledgements

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Efficient Search Methods for Database Backed Web Applications

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Abstract: Searching database backed Web applications with dynamically generated HTML pages differs considerably from searching static document trees or databases directly. Universal relations and natural language interfaces known from database theory are combined with keyword searches known from the Web to define a metadata model for searching a database backed Web application. The key idea here is the separation of structural and contextual meaning of words. Based on this idea, natural language interfaces, and generic interfaces for both Intelligent Software Agents and robots from search engines have been implemented. This short presentation will give an overview of the status quo of this ongoing research and will show future directions.

Search Methods on the Web and in Relational Databases

Searching database backed Web applications with dynamically generated HTML pages differs considerably from searching static document trees [http://www.sci.ouc.bc.ca/libr/connect96/search.htm] or databases directly. However, the disadvantage with relational query languages is that one has to know the exact names, relational topology and the semantic meaning of this structure (e.g. entity relationship diagram) to formulate a useful query to the database. An interesting approach to overcome some of this deficiencies are 'Universal Relation' query languages. Although universal relations are not the best solution for searching in database backed Web applications, the idea of a path through the database will be used for the approach proposed here. On the Web - and hence also for database backed Web applications - only two methods of querying are realistic - keywords and natural language interfaces NLIs [Trost & Buchegger 1990]. Nobody would expect the average Web user first to learn the scheme of the underlying database and then to formulate a proper query directly with SQL. Keywords are the usual method of searching today, but more recently Altavista has started a pilot with short NLI queries.

A Natural Language Interface for Database Backed Web Applications

The key idea is to differentiate between the structural and contextual meaning of keywords. The structural keywords are used to select a path within the database topology (i.e. a particular attribute of a table or a whole SQL statement). A full-text search then detects the occurrence of the contents keywords within the pre-selected path. Similar ideas - called 'keyword separation' - can also be found to search static hypertext systems. Other papers suggest rich links [Oinas-Kukkonen 1998] or meta-level links [Takahashi 1998] for better navigation and queries. Yet compared with linked hypertext structures, the structure of a relational database (and especially the semantically richer ER description) contains even more information. The basis is a configuration repository (stored as relational data structure) which defines a semantic metadata model of the database.

The algorithm: First, the starting phrase and ,uninteresting 'filling' words of natural language utterances are eliminated. Then the query input is searched for structural keywords. For each keyword found, the other keywords are treated as content keywords and the parametrized SQL statement is then filled with the content attributes and executed as often as necessary. The results are formatted according to the presentation rules of the respective path. These results are links, the anchor tags are built from the URL definitions filled with the names and values of the attributes found. A click on one of these results brings the user directly to a point within the database application that reflects the query results.

Again, we are searching database backed applications with dynamically generated HTML pages, but neither static documents nor databases directly. Here the task of the search interface is to bring the user into the right starting point within the application rather than giving him a perfectly precise search result: The user can then - with the possibilities of the application itself - proceed further to the desired information. Hence it is only important to place the user somewhere near the desired results within the application.

Agents, Robots and Search Engines

The key idea in providing an agent [Kiniry & Zimmerman 1998], [Chorafas 1998], interface for a database backed Web application is to encapsulate the search functionality described in the previous section within an agent called 'database guardian'. It is able to talk to other agents, either with short messages, or with an intelligent language like KQML (Knowledge Query and Manipulation Language) [Chorafas 1998] or ACL (Agent Communication Language). From the other agent's view this version of the natural language interface would look as if the guardian knows the database application and can hence communicate it to others. A personalized agent with a particular task can now migrate on its own through the Web and eventually find our database, communicate with our guardian and -- in the case of success -- report back home on what it has found. The prototype has been implemented using IBM's Aglets [http://www.trl.ibm.co.jp/aglets/]. One obvious enhancement of this agent approach is to let the database itself send out agents - either to provide the contained information actively, e.g. to meet information seeking agents at virtual marketplaces, or to seek new information to be stored in the database.

Search engines use programs - called robots, wanderers, or spiders - to index the whole Web [http://www.ouc.bc.ca/libr/connect96/search.htm]. The problem with search engines and database backed Web applications is that the latter need links with lots of parameters in their URLs, which the former sometimes ignore. Hence we need static pages which the search engines can bookmark. The first straight-forward approach is to generate one large static page. The disadvantage, however, is that for a very large database this would mean loading the textual representation of the whole database over the Web. The alternative is to repetitively build a static hypertext tree from the database, following the entity relationship structure. An algorithm can be applied using graph theory [Goeschka 1998]. The contents of the generated pages is derived from the same repository as described earlier, especially from the part, where the entry points for single tables are defined. This method enables the bookmarking of the whole database contents by any search engine with reasonably small pages and the possibility to jump into the dynamic application. This method can also be applied with intelligent agents, that expect a static hypertext tree to traverse. In fact, the static tree is not really built, but rather dynamically simulated from virtual extra paths by the static tree engine.

References

Chorafas, D.N. (1998). *Agent Technology Handbook*. McGraw-Hill.

Goeschka, K. (1998). *Architectures of Web Applications*. Ph.D. Thesis at the Vienna University of Technology, Vienna, Austria.

Kiniry, J.; Zimmerman, D. (1998). *A Hands-on Look at Java Mobile Agents*. IEEE Internet Computing, Vol. 1, Nr. 4, pp. 21-30.

Oinas-Kukkonen, H. (1998). *What is Inside a Link?* ACM Comm., Vol.41, No.7, July.

Takahashi, K. (1998). *Metalevel Links: More Power to Your Links*. Communications of the ACM, Vol.41, No.7, 1998.

Trost, H.; Buchegger, E. (1990) *Datenbank-DIALOG: how to communicate with your database in German (and enjoy it)*. Austrian Research Institute for Artificial Intelligence, Butterworth-Heinemann.

Web Utilization of Relational Databases with Dynamically Generated HTML

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Abstract: While databases store information and the Web is the place for the gathering and distribution of information, there are inherent difficulties in linking them together. Often proprietary methods compromise Web compatibility. This paper presents a design methodology to use groups of pure HTML hyper-links for sophisticated user interaction with relational databases. The key idea is to use a Finite State Machine model. A Web based toolset has been implemented to generate the different applications thereby also fostering unlimited Web collaboration. Using this technique, complete real-life information systems have been built. The proposed techniques will also help to provide new ways to integrate legacy systems.

Web Information Systems

While databases process and store information and the Web has turned out to be the place for gathering and distributing of information [Isakowitz et al. 1998], integrating them is quite difficult. However, it soon turned out that most real-life applications need an underlying database on the server side and many legacy database systems need to be connected to the Web [Adida, 1997].

If the user interface has to work with any browser and should not depend on proprietary non-standard extensions like Plug--Ins, Active--X, VBScript or JavaScript then the user interface is restricted to the possibilities of pure HTML (Hypertext Markup Language). This concerns the representation, but the user interaction even more so - the only functional elements are following a link, pressing a submit button of a form or clicking on an image or imagemap. They always result in an HTTP (Hypertext Transfer Protocol) connection. Hence, any functionality resides on the server side.

Another problem arises due to the different nature of databases and the Web: The HTTP is stateless and the browser does not store its user interface state but connection orientation is inevitable for real-life database transactions. To overcome this deficiency, we use Short URL (Uniform Resource Locator) encoding: A short session identifier, called a handle, is passed back and forth between client and server with every HTTP connection. The complete session state information (database transaction state and user interface state) is kept on the server side, usually in a database. This approach scales well to complex state information and it can also be used with frames.

Architectural Model

Being limited to an HTML-only user interface, we are confronted with a disadvantage with HTML forms: no functional dependencies between different input fields of a form can be implemented. An HTTP session has to be performed before functional dependencies or restrictions can affect other inputs. To achieve this HTTP session, a submit button has to be explicitly pressed. It is not usually enough to fill in an input field or make a selection. The key idea of this approach therefore is to use links to solicit user selections. Control elements are thus constructed of sets of links grouped together. These links are a means of user interaction, no cross-references or links for navigation! This approach is reasonable for a typical Web application where most user interactions consist of browsing, selecting and collecting information from the database. The possible values for user input are predefined in these cases.

The general idea of modeling hypertext documents as Finite State Machines is well proven [Stotts et al. 1998]: It is proposed to view a document as an abstract automaton that specifies the process of browsing within it. The linked structure of a document can usually be thought of as the state transition diagram of a FSM. Hence each document defines a state (i.e. the state that this document is displayed in with only one document being displayed at a time) and the state transitions are provided by the hyperlinks. Clearly this describes a FSM with a finite set of pages (states) and a finite set of links per page. The most important difference between a database backed Web application and a static document tree is the number of pages: In the latter case this number is well defined, whereas in the first case the number of dynamically generated pages is potentially infinite due to the arbitrary nature of the Turing machine which is formed by the database application. Nevertheless, the theory of FSMs can still be applied [Goeschka, 1998].

The strict separation between state transition and output generation is a key feature of this model to achieve stable and robust Web applications: It is necessary to guarantee a deterministic generation of the dynamic HTML pages independently from the last user interaction. Hence, as long as the affiliated state information is not changed, a dynamically generated Web page will always look the same, regardless of which user interactions have taken place in the meantime. Web applications which ignore this rule can easily produce unpredictable results and a corrupted output. Again, the two reasons for this are the stateless nature of the HTTP protocol and the browser. Hence, if a user interaction has to produce a different output, it first has to change the session state information, making it possible to generate the new output from the changed session state information afterwards.

Implementation and Conclusion

Whereas the advantages of a client/server model are exploited for design, in the case of pure HTML the final implementation of a PHC is done on the server side. Every Web page, including all links, is dynamically generated from the database. The hyper-reference URL of every link contains parameters for the global session handle and state transition information. The lifetime-problem of state information is overcome by a time-out mechanism. The problem with the browser cache that every URL-based state maintenance mechanism has to face can be overcome by setting the HTTP response header field 'Expires' to a date in the past.

Evaluation of the design and generation methods has been done by two sophisticated, multi-lingual, real-life implementations. A product marketing and tourism information system (http://land.ict.tuwien.ac.at/) and a Web based interactive database training server (http:/aki.ict.tuwien.ac.at/) for a graduate course with 90 students per year. Hence it is proven, that the approach scales to larger systems. Despite the limits of pure HTML, sophisticated user interfaces could be designed. With the Web based tools, a novel design and implementation technique for complete Web based information systems was implemented. This development framework can also provide new ways to integrate legacy systems.

References

Adida, B. (1997). *Database-backed Web sites*. IEEE Internet Computing, Vol. 1, Nr. 6, pp. 78-80.

Goeschka, K. (1998). *Architectures of Web Applications*. Ph.D. Thesis at the Vienna University of Technology, Vienna, Austria.

Isakowitz, T.; Bieber, M.; Vitali, F. (1998). *Web Information Systems*. ACM Comm., Vol.41, No.7.

Stotts, D.P.; Furuta, R.; Cabarrus, C.R. (1998). *Hyperdocuments as Automata: Verification of Traces-Based Browsing Properties by Model Checking*. ACM Transactions on Information Systems, Vol. 16, No. 1, pp. 1-30.

Tools for Intelligent Learning Applications in The Internet

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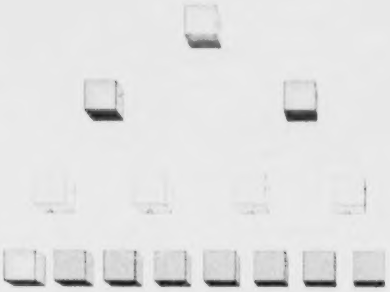
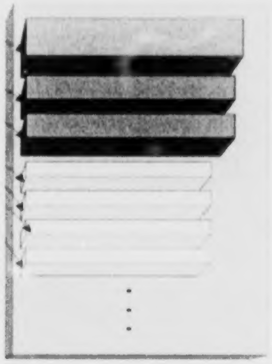
Abstract: Using hypertext to support work, learning and research, has have increasingly popular. The user can arbitrarily navigate in the information space. Yet many approaches do not consider the aims, interests and the knowledge of the user. This paper introduces a method for the intelligent and dynamic generation of hypertexts from an information space, and for the support of navigation in large, complex hyper documents, which is based on the modelling of the application domain. Intelligent generation of hypertext is based on different inference strategies, for horn clause resolution. The generated hypertext is problem-oriented and presented in a context sensitive manner. Furthermore, the structure of the hypertext is presented graphically and serves as a navigation support for the user. All tools related to this work are implemented in Java.

1 Introduction

The deployment of hypertext to represent knowledge and information has gained popularity over the last years, not least due to the WWW. Hypertext allow a non-linear representation of knowledge and information. The user can move freely within the information space. Unfortunately, this flexibility has its drawbacks. Big hypertext systems quickly leads to user disorientation. The user is lost in the web of links. When hypertext is used for learning, teaching and working, this phenomenon will occur very soon. Many solutions have been proposed to deal with this problem, but none of the suggestions really appreciate the aims and the interests of the user.

This work introduces an approach to solve this problem. Our approach support, the intelligent generation of new hypertext from an information space and a proper navigation help in complex hyperdocuments. To support the user during learning, researching and working with big information spaces the approach generates an appropriate hypertext, to bring into account the interests, the knowledge and the aims of the user. Thus the generated hypertext is extremely problem-oriented and context-sensitive, and will be presented in an appropriate manner. These properties qualify our approach for the area of teaching and learning especially in intranets and the internet.





2 Approach

Rule interpreter can be used to find answers to the users's questions. They use a dedicated knowledge base, which describes the basic knowledge of the system. Additionally, they accept input from the user, which will be interpreted as a question. Using the knowledge base the interpreter tries to find an answer to those questions. Regardless whether or not a clear answer can be found, it establishes a solution path.

The quality of the generated hypertext depends on this solution path. The clearer it is, the better the quality of the generated hypertext. The measure of the quality is described through the information pieces in the generated hypertext which are related to the question.

The tree, which is built at run time, has different kinds of nodes, which serve different purposes. The first kind of nodes is the *root* of the tree, which represents a global target. The root also has the properties of the inner nodes. They are the second kind of nodes, representing the derivation of the solution, i.e. the rule of the knowledge base. The inner nodes also have additional references to contents, which are related to the subject of the rule. The content might be text, audio, video or other multimedia data. A node may have several references with different types. The third kind of nodes are the *leafs*, which represent the input of the user, consisting of prescribed facts.

There are two different ways to build up a tree. Both cases need a root and the leafs, the user has to supply the input. The difference is the starting point of the algorithm, which may start of the root and tries to get the leafs or vice versa, i.e. starting with the leafs and getting the root.

These schemes are realized in two different interpreters. The first is realized in an interpreter like PROLOG, i.e. it works backward chained. The second scheme works the opposite way and is realized in an interpreter that works forward chained.

At interpretation time the interpreter generates a tree, the solution path. The nodes of the tree represent an ordering of the information space. When considering the tree the choice of a node of the next level, depends on the nodes of the prior level. Following this scheme to the start of the algorithm, one obtains the input of the user. The difference to other systems is that the users input is not limited to keywords. Like to the rules in the inner nodes they have explicit references to the information space and are prescribed by the system.

3 Discussion

In this paper we have introduced an approach for the intelligent generation of hypertext which is context-sensitive and problem-oriented. The approach supplies a method to support the user in a context-sensitive and problem-oriented way at his work, learning and research. Additionally, a navigation support, which is based on the same method, are also been introduced it handles large, complex hyperdocuments. All tools related to this work are implemented in Java as applets and applications. Thus, they can be used within web-pages and as standalone applications. The tools can be used in the internet and also in intranets like in big clinics, firms and schools or universities. All tools are integrated in the HTML-Version of the DSM-IV[1].

4 References

[1] American Psychiatric Association: Diagnostic and Statistic Manual of Mental Disorders, Fourth Edition. American Psychiatric Association, Washington D.C., (1994).

[2] C. Spreckelsen, I. Houben, M. Günes, K. Spitzer, H. Sass (1997), Wissensbasierte Navigation in einem hypertextbasierten Assistenzsystem für die Psychiatrie, In: H. Conradi, R. Kreutz, K. Spitzer (Hrsg.) CBT in der Medizin - Methoden, Techniken, Anwendungen, Proceedings zum CBT-Workshop (Aachen, 06.-07. Juni 1997), ISBN: 3-86073-574-8

[3] M. Günes, Entwicklung einer wissensbasierten Navigationsunterstützung zu einem WWW-basierten Assistenzsystem für die Psychiatrie in Java, Master Thesis, RWTH-Aachen, 1998

[4] Rainer Kuhlen, Hypertext: ein nichtlineares Medium zwischen Buch und Wissensbank, Springer-Verlag, 1991

The Importance of Link-Transformation and Link-Proposals for Hyperlink-Management Systems

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Abstract: This short paper emphasizes on a special aspect of hyperlink-management systems as part of online authoring systems. The transforming and adopting of links in HTML-files is very important. This can be done only if there are relationships between the corresponding documents. Another aspect is strongly related to the first one: the generation of link proposals for new documents. Both ideas together lead to a very efficient and user friendly management of hyperlinks.

Link management in general

The Internet, especially the World Wide Web (WWW), is growing very fast. There are millions of documents retrievable from the net. One main reason for the success of the WWW is the possibility to connect HTML-files via hyperlinks. The idea is to improve the quality and usability of documents while offering additional information within the reach of a single mouse click.

Hyperlinks are one of the most important ways to find an HTML file on the Internet. Unfortunately they are also very hard to manage. Due to the structure of the HTML code, the renaming or moving of a file requires several changes within the hyperlinks of the concerned documents. Improper handling of the hyperlink-management may result in broken links or unsuitable references.

There is another aspect that is gaining more and more importance as well: For multilingual web-sites, a relation has to be established between documents of the same content which exist in different language-versions. If there is a change in one document, all other language-versions of the same document-content should be altered accordingly. It is important that the language-specific links of the original document do not get copied with a "one-to-one ratio" into a document that has the same content but is written in a different language. Rather, the "transformation" of the link should take place as follows (figure 1):

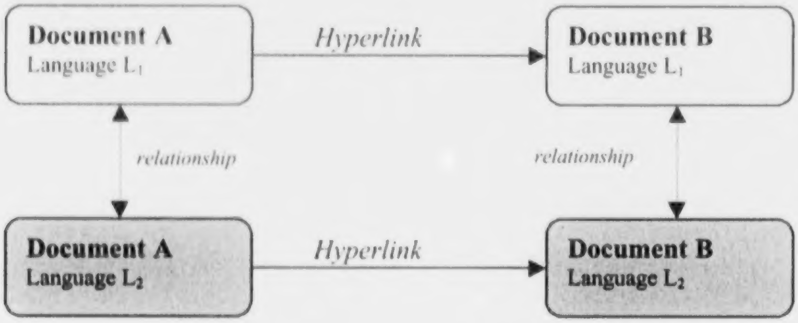

Figure 1: The relationship between documents

In the scenario described above, the transformation of a link into another language is quite straightforward. But there are also many situations where the finding of suitable links turns out to be a very hard job. How can one make a proposal for hyperlinks in a document A in general?

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The idea of this short paper is to find the most *similar document S* to A and to take the hyperlinks of S as proposals for A. The calculation of the similarity is a complex process, because there are some inherent difficulties in the definition of the similarity itself [Tverski77].

A practical example

In a hyperlink-management system devised by the Institute of Telematics, we have used five different kinds of partial similarities between HTML-documents for calculating their total similarities:

(1) evaluation of the similarity "MK" between the weighted, normalized (meta)-keywords
(2) evaluation of the similarity "MD" between the (meta)-descriptions (on the basis of a pure word-check)
(3) degree "MA" of correspondence between the authors (with regard to the ranking of the authors)
(4) comparison of the document-validation and the expiration time "MT" (creation and expiration time are considered)
(5) comparison of all document catchwords "MC" (analogous to the meta-keywords)

According to the normalization of the keywords and catchwords (1),(5) it must be taken into account that there are not only grammatically variants but also different languages.
All results MK, MD, MA, MT and MC may have values between 0 and 1, where 0 means "no similarity" and 1 means "identity". Each partial similarity is weighted by a system- dependant, constant, positive value (WMK, WMD, WMA, WMT and WMC respectively) with no further restrictions.

Thus, the total similarity TS between two documents is calculated by dividing the weighted partial similarities through the sum of the weights [1]:

$$TS = \frac{MK \cdot WMK + MD \cdot WMA + MT \cdot WMT + MC \cdot WMS}{WMK + WMD + WMA + WMT + WMS} \quad [1]$$

The total similarity between two documents must exceed a reasonable threshold-delta (e.g. delta > 0.75) to be an indicator of a candidate for link-proposals.

The research in this field is still in progress and we hope to get valuable results about this approach soon.

References

Amos Tverski, Features of similarity (1977), *Psychological review*, pp. 327-352

The Take-Up of Web Technology:- Adoption & Diffusion into Mainstream Teaching

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Abstract. In 1998, at the the University of Western Sydney Macarthur, a project called PlatformWeb was introduced to enable a "bulk" movement of teaching staff to make use of the Web medium for teaching delivery. From a comparison of models of adoption of teaching innovations, it was decided to approach this project by making use of the Burkman "User Instructional Orientated Development" model. Instead of simply adopting an off the shelf web delivery package, from surveying staff perceptions of needs, a fully integrated Web Information System incorporating the Student Administration System was developed. Using this adoption model, within two teaching semesters, there has been a voluntary movement of about 200 staff and subjects into making use of PlatformWeb. This involves about 3,000 active student users and up to 6,000 students with access. The daily usage being 40,000 to 60,000 items accessed via the web. This paper outlines the adoption model and the development of the Web Delivery System.

Introduction

The adoption of web based education represents an example of Instructional Technology Diffusion as part of the standard Innovation Decision Process theory [Rogers, 1995], with the prediction that individuals who are predisposed to being innovative will adapt an innovation earlier than those who are less predisposed. On one extreme of the distribution are the "Innovators On the other extreme are the "Laggards" who resist adopting an innovation until rather late in the diffusion process, if ever. The diffusion process following an "S" curve. The PlatformWeb project aims at moving the rate of adoption of the web medium in education along the "S" curve as quickly as possible.

Applying the Burkman Model

In particular the approach of Burkman's [Burkman, 1987] theory of user-orientated instructional development (UOID) was used. This model sees the needs, and perceptions of the potential adopters as being the primary forces that influence adoption. The UOID process consists of 5 steps, each of which is concerned about the characteristics of the individual adopter: namely, (1) Identify the potential adopter,(2) Measure the relevant potential adopter perceptions, (3) Design and develop a user-friendly product, (4) Inform the potential adopter (of the user-friendliness), and (5) Provide post adoption support .

Preliminary Work

The adopters were identified as primarily (at this stage) the teaching staff, as without them there would be no web based delivery to students, with the University management and students as secondary. It was recognised, as the project developed, that the primary adopters would shift towards the students as staff came "online". Adopter (staff) perceptions were sampled in terms of real or perceived problems firstly in existing traditional teaching delivery and secondly in moving to web based teaching.

Real or Perceived Problems with Traditional Teaching Delivery (as seen by staff)

Staff were surveyed on their perceptions to traditional teaching in the broadest scope (not just of their perceptions inside the lecture room). The main concerns were grouped into three main areas. These are in order of importance were (1) General administration problems in subject delivery dealing with student enrolment, timetabling, and resource availability. (2) General and specific communication to/from students resulting in student (and staff) confusion of procedures, requirements and where to obtain needed information (3) Student participation and attitudes towards attendance at lectures and submission of assignment work

From this survey work, there emerged a prime importance of the administration information systems in supporting existing traditional teaching methods (for the bulk of staff). The survey also indicated that some (if not many) of the attitudes students develop regarding their learning experiences (particularly in large subjects) are influenced by the administration related problems encountered in the first few weeks of their studies, particularly regarding communication with the staff and administration.

From an examination of a number of commercial teaching delivery packages, there is currently a lack of administration integration due to either proprietary backend databases and lack of data "gateways" [Sawers and Alexander, 1998 make interesting and candid comments of these types of problems with a major university implementation].

Real or Perceived Problems with moving to web based teaching delivery

The main concerns for this area were grouped into three main areas. (1) Developing and learning web technology. Except for a few "trend setters" the bulk of the teaching staff had reservations on spending the time and effort in learning how to produce and author web based material. Also put forward was the concern of "locking in" to vendor specific methods if a commercial web delivery product were to be used. (2) Making use of existing materials and resources. Since most staff had developed over the years, considerable amount of material in traditional form (typically quizzes, notes and slide presentations), a major concern was how these could be easily incorporated into web delivery. (3) Technology and network issues. The typical concerns being student access, bandwidths, multiple passwords to access various websites and available computer facilities.

Design of PlatformWeb

The PlatformWeb project started with a bare bones implementation, integrating the Student Enrolment system for automatic daily updates with simple uploading management structures that can include almost all forms of legacy material, and supplying a online student messaging system. Students and staff access the system from one entry point, which lists the subjects relevant to the user. Later added were online quizzes, student upload modules for assignments, online marking, online discussion groups and various administrative functions. Specifications for these being generated from staff perceived needs, experience and feedback.

Results and Conclusions

From the original trial with 800 students and 19 subjects, The PlatformWeb project has become a "teaching companion" for not just the innovators but also for the "bulk" staff population. There are currently about 200 subjects and staff using the system with about 3,000 active students (once a day access). This has resulted from staff demand rather from management directives. Further details on the pilot study in [Hansen,1999]

References

Burkman, E.(1987), *Factors Affecting Utilization*, in R.M. Gagn (ed), Instructional Technology Foundations, Hillsdale,NJ:Lawrence Erlbaum

Rogers, E.(1995), "Diffusion of Innovations" 4th Edition, New York: The Free Press

Sawers J, Alexander S (1998), "A Centralised Approach to the Adoption of a University-Wide Web-Based Learning Tool", Proceedings of 1998 ASCILITE Conference, NSW, Australia

Hansen S, et all (1999),*Adoption of Web Based Delivery by Staff in Educational Institutions: Issues, Strategems and a Pilot Study*, Proceedings of Ausweb99, Ballina, Australia 379,395

Agents in Digital Libraries and Electronic Publication: An Architecture Proposal

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Abstract: Intelligent agents can be effectively used to structure a whole digital library and play and active role in the electronic publishing process. In this work, a Virtual Research Digital Library (VRDL) based on an architecture of agents is presented, with the roles of each agent explained and their interactions shown.
Keywords: Digital libraries; Software Agents; Electronic Commerce; Electronic Publishing

1. Introduction

Agents have been in the past and are currently being used in several areas. One of the areas where they can have an important role is the digital library area, in general, and more specifically, the electronic publishing process. In fact, agents can help to structure a Virtual Research Digital Library (VRDL) and help each of the participants to fulfil its goals. In this work this idea is developed through section two where the agents role in electronic publishing and digital libraries is presented, and section three where an architecture to achieve this is proposed.

2. Agents Role in Electronic Publishing and Digital Libraries

A possible and original digital library definition is the following [Gladney 1994]:
"A digital library is an assemblage of digital computing, storage and communications machinery together with the content and software needed to reproduce, emulate, and extend the services provided by conventional libraries based on paper and other material means of collecting, cataloguing, finding and disseminating information. A full service digital library must accomplish all essential services of traditional libraries and also exploit the well-known advantages of digital storage, searching, and communication."

From the given definition, one may conclude that digital libraries are a set of well organised technologies and, above all, a very important source of structured, well organised and well stored information. It is clear that digital libraries can help to store and even organise the results from a electronic publication process: authors works (i.e. a paper).

The above described can be accomplished through the use of agents. In fact, we can conclude that agents, besides their expected roles (i.e. information location), can host an architecture (contributing to the concept of an organised technology) and play important roles within that architecture in order to establish a digital library. By playing these roles, agents are not only intermediaries between the parties but also actors in the process (solving the structure, organisation and storage information requirement).

Moreover, agents can also have an active role in the electronic publishing process (i.e. of a paper) where we can consider that there are up to four phases (modified from original phases of the traditional publication process - see [Denning & Rous 1995]): Preparation, review and revision, publication processing, and archiving and indexing. The agent architecture described can play a key role in all the phases:

- by helping the author to submit his work to several editors;
- by helping out editors to forward the work to the right reviewers;
- by forwarding it to an on-line journal;
- and finally by archiving and indexing it on a WWW repository (an on-line database or a a digital library).

Through the above-described agents can effectively help to bridge the gap between information producers (i.e. authors), publishers and information consumers.

3. Architecture proposal for the VRDL

In the proposed agent architecture, which basically is an information distributed service over the Internet, each type of agent has a specific role. The architecture is composed of the following eight different types of agents:

- *User interface agents (for consumers)* - agents responsible to interact between the information consumer and the rest of the system. Each user has one of these agents;
- *User interface agents (for authors)* - agents responsible to interact between the author of an information work (i.e. article, thesis) and the publishers or the consumers. Each author has one of these agents;
- *Publisher agent* - agents responsible to interact between the publisher and the authors or the consumers. Each publisher has one of these agents;
- *Information retrieval agents* - agents responsible for finding the required information for a consumer. Each consumer has one of these agents. They interact mostly with the directory and publishers agents through the broker agent;
- *Broker agent* - central agent responsible to receive and send information (i.e. journal title, abstract, number of pages, price) between participants. It has the responsibility of interacting with all agents;
- *Directory agent* - this is an agent that has lists of publishers and authors. It is contacted by the information retrieval agents and contacts publishers agents regularly to have updated lists (all this through the broker agent);
- *Quantity agent* - this is an agent that can get several requests for the same article and then negotiate a lower price (because buying in bulk quantity) for each information consumer requesting it (through the broker agent);
- *Referee agent* - agent that represents accredited referees. It is responsible for finding specific information works (i.e. article) to be referred and presenting it to the referee person and after, to communicate the results from the referring to the publisher agent (through the broker agent).

The proposed architecture is currently being developed with the ZEUS agent system (http://www.labs.bt.com/projects/agents/index.htm) from British Telecom. This agent development environment has a very important characteristic: The agents are produced in the Java language, which is very important for platform independence and communication between all party systems.

4. Conclusions

It was argued in this paper that agents could be used to specify a digital library, and also play an important role in the electronic publishing process. An architecture for these purposes was presented with eight types of agents specified and described. In the future, this architecture, which is being implemented at the moment, will be tested and its results evaluated in order to conclude or not for the validity of this approach in practical terms.

5. References

[Gladney 1994] Gladney, H. M. (1994). Digital Library: Gross Structure and Requirements (Report from a March 1994 Workshop). In *Proceedings of the Conference Digital Libraries '94*, Available: http://abgen.cvm.tamu.edu/DL94/paper/fox.html [1999, September 2]

[Denning & Rous 1995] Denning, P., Rous, B. (1995). The ACM Electronic Publishing Plan, *Communications of the ACM*, Vol. 38, N. 4, pp 97-103. Available: http://www.acm.org/pubs/epub_plan.html [1999, September 2]

The Windows to the Universe Web Site - Lessons Learned after Four Years of Development

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Abstract: Since 1995, the Windows to the Universe web site (www.windows.umich.edu) has been presenting Earth and space science content to the general public and the science and education communities. Windows to the Universe has been widely acclaimed and has seen exponential growth in users of the site. As might be expected, we learned a number of lessons that would have been more convenient to have known at project inception.

Introduction

The highly acclaimed Windows to the Universe web site (www.windows.umich.edu) is now in its fourth year of development. This site provides public access to interdisciplinary Earth and space science information, data, and educational resources in home, classroom, library and museum settings over the internet. The site consists of ~5200 html files, ~5300 image files, and ~400 image maps which span concepts in the Earth and space sciences, ranging from the Earth as a planet to astrophysics. Windows to the Universe has experienced dramatic user growth over the past four years, reflecting the growth in internet use by the public as well as the growing use of internet technology in the classroom (Figure 1). Over the past year, the site was visited by 2.5 million users, serving 15.3 million pages and corresponding to ~60.2 million hits on the site.

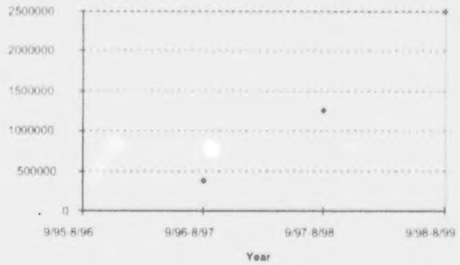

Figure 1: Number of User Sessions per Year

Users of the Windows to the Universe project range from 5 to 85, and include a large number of students and teachers. The success of the project and extensive dissemination efforts have succeeded in attracting the attention of users from around the world, many who are using the site in support of their classroom Earth and space science

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education program from elementary school through the undergraduate level. Unique aspects of the project include the three levels of content development, that allow users of all grade levels to access content appropriate to their reading level, as well as the availability of a supplementary CD that allows users to rapidly access images integrated into the web site from their local drive, conserving download time. These features have been very popular with our users in the precollege education setting. Windows to the Universe provides excellent, comprehensive science content presented at the level of their students and integrated into an interdisciplinary and attractive presentation format.

Lessons Learned

Our project was initiated in 1995. Much of the knowledge and many of the tools web developers now have at their disposal were not yet available. Similarly, although our development team included a wide array of individual expertises, including Earth and space scientists, precollege educators, programmers, artists, and outreach specialists from the museum and library community, we did not have extensive experience in web site development when our project was initiated. As a result, our project developed, along with our expertise in web site development, while riding the wave of expanding internet technologies and use.

Several aspects of the project can be identified that allowed us to succeed in this environment. A key factor was the inclusion, from the beginning of the project, of an on-going evaluation effort. This includes analysis of user interaction of the site through log analysis as well as on-line and hard-copy surveys. Through these evaluation efforts, we collect information about the design of the overall site and the perceived impact of the site content on the understanding of the Earth and space sciences by students, teachers and the general public. Another key factor at the beginning of the project was the adoption of a rapid-prototyping development cycle that allowed us to plan, develop, implement, evaluate, and revise rapidly enough that we could modify plans for the project to accomodate to the changing technological environment as well as to developments in computer-based science education. The coupled effect of these two factors has been to allow us to use our user audience, in part, as co-designers of the site.

Although our initial team included much of the expertise required to accomplish the goals of the project, we discovered along the way that several additional skills were needed. These included the skills of a legal advisor, copyright specialists, and translators, in addition to the administrative assistance that is so easily underestimated for a project of this size. As we developed our project to our rapid-prototyping schedule in a university environment, interesting cultural issues developed that required team members to adopt new modes of working. Working on a product-based development cycle is not common in a university or research institution, and team members had a difficult time adjusting to this schedule, and balancing project requirements against their research activities. All team members brought their own quite different cultures to the project, requiring adjustment from all members in order for the project to be successful.

As might be expected, we learned a number of lessons that would have been more convenient to have known at project inception. As the project developed, it became clear that methods for automatic updating of pages on the web site were necessary, and this needed to be implemented while the project was already underway. Similarly, after the project was initiated, we discovered the need to develop a number of search capabilities, including searches based on keywords, which required implementation after the site already consisted of more than 1000 html documents. Finally, we underestimated the staff-time required to support new functionalities on the site in the "Ask-A-Scientist" and "Headline News" areas.

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Development of Web-based University Courses - A Cultural Perspective

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Abstract: Web-based courses at university level provide several advantages and flexibility for students and educators. Presenting course material in such a fashion is a relatively new challenge to educators. Rapid developments in Internet technology has spurred developments in web-based applications and authorware, leading to the feasibility of developing multimedia courseware without having thorough training in the use of hardware and protocols. This paper presents an argument about the importance of cultural issues in a web-based course in a multicultural university. This paper identifies significant cultural issues and discusses studies in progress about students from different cultural backgrounds using web-based courses. The study attempts to define web-based system components from the perspective of effectiveness of course delivery in a multicultural university.

1. Introduction

It is generally accepted that contact curriculum delivery at universities will not cease in the near future. Courseware delivery through hypermedia has had some impact on traditional academic practices. Because of their non-contact nature and associated flexibility, web-based courseware provides several advantages for course delivery. Courseware delivered through web-based hypermedia applications is inherently multi-user and multi-site in nature. Many users can work on a web interface at the same time and in different locations - day or night. Moreover, popularity and economics of the Internet is increasingly making it feasible for educational institutions to consider course delivery through a web-based system, at least in parts.

Web-based delivery systems can promote change in the student-trainee/teacher relationship compare to the traditional teaching system. The trainer/teacher shifts his/her role as initiator, motivator and educator and educationalist towards being a sporadic expert, indirect motivator, planner and facilitator [Sherry & Wilson, 1997]. Part of the teacher's traditional tasks are passed to the students, the course group or the system [Ringsted, 1992]. However, new tasks are added to the role of the teacher. These include media description, development of distance learning methodology, coordination and organisation and participation in a production team for authoring tasks. These roles complement differential learning styles and cognitive patterns used by on-line learners.

On-line learners work in a collaborative, social structure where they and their teacher/facilitator generate knowledge and interact [Palloff & Pratt, 1998]. It is argued that a web-based course delivery system is an ideal environment for completing lessons for all students, as they can pace themselves [Duchastel, 1997]. Recent work by Slay (1998) and Bauer (1998) suggest that on-line learning can be especially important in case of students from non-English speaking backgrounds.

The quality of teaching and learning on the web-based system encourages students to take the advantage of interactive learning and learning through a process of trial and error. This approach of interactivity, discovery learning and graphical interaction, creates a particularly favourable environment of this type of learning [Revel & Bessiere, 1992]. Human ability to visualise parts such diagrams leads to relating to similar experiences that were faced previously and somehow has relevance to the present moment. This leads to the availability of a large amount of visual metaphores that can be used for precise expression within a knowledge domain. Graphical interaction provides a powerful principle of representation, analysis and action based on the individual students' personal experiences. In a multicultural university environment, design of courseware delivery systems supporting information can use a number of tools including graphical icons, colours, representation of information in more than one format to generate effective learning [Revel & Bessiere, 1992]. However, there is a need to redress the differential learning patterns imposed by culture and the way knowledge is socially constructed by individuals from different cultural contexts.

2. Importance of the study cultural factors

Building on the seminal work of Hofstede (1991), there is agreement amongst web-based course developers that culture has a definite and very strong influence on the design and use of information, communication and learning systems [Henderson et. al, 1996]. The perspective on individual differences has to do with cultural, ethnic, racial, or linguistic background [Fernandes, 1995]. Most of the existing web-based tertiary courses are currently designed such that the developer assumes that the user demography pertains to a single culture background (usually English speaking). Perceptions due to cultural influences are two way processes. Not only the learners are effected by their cultural backgrounds, but also the designers express their ideas, influenced by their cultural background [Wild & Henderson, 1998]. Creating an effective multi-cultural leaning environment remains a challenge of on-line learning and teaching.

3. Future investigation

Culture is a culmination of ways in which an identifiable group adapts to its environment. Hence, Learners/Teachers often belong to more than a single cultural group embodying a subset rather than totality of a culture's identifiable characteristics and they may not maintain their cultural characteristics to their birth culture [Scheel & Branch, 1993]. Humans evolve due to their changing environment and adaptive nature. This study is investigating design and development of components of web-based tertiary courses for multi-culture background learners. The by product of this study will be expectations from web-based learning apart from more information about learners' and teachers' cultural backgrounds. The study will yield information about how learners from different culture background effectively learn and how university course structure can be improved by web-based delivery.

4. References

Bauer, C (1998) On-line Education: Students' Perceptions of Web-Based Teaching (Poster Presentation) in Proceedings of the Conference on Electronic Commerce, University of Wollongong.

Duchastel, P. (1997) A web-Based Model for University Instruction", *Journal of Educational Technology Systems*, 25(3), 221-228

Fernandes, E. (1995): *Global Interface Design: A guide to designing international user interfaces*, Academic Press Professional,.

Henderson, L (1996): "Instructional design of interactive multimedia: A cultural critique ", *Educational Technology Research and Development*, 44(4), 86-104.

Hofstede, G. (1991): *Cultures and Organisations: Software of the Mind*, McGraw-Hill, London.

Palloff, R. and Pratt, K. (1998): "Effective Teaching and learning in the Virtual Classroom", in Proceedings of World Computer Congress: Teleteaching 98, Vienna, Austria/ Budapest, Hungary, August 1998.

Revel, J.V. and Bessiere, J. (1992): Playing Graphics in the Design and Use of Multimedia Courseware", On-Site Distance Learning: A Multimedia Full-Scale Experiment in Denmark", Multimedia Interface Design in Education, NATO ASI Series F: Computer and Systems Sciences, Vol. 76, 57-82.

Ringsted, M, (1992): "On-Site Distance Learning: A Multimedia Full-Scale Experiment in Denmark", Multimedia Interface Design in Education, NATO ASI Series F: Computer and Systems Sciences, Vol. 76, 43-56.

Scheel N., & Branch, R. (1993): "The role of conversation and culture in the systematic design of instruction", *Educational Technology*, 3(3), 1-14.

Slay, J. (1998): Using the WWW to create an effective cross-cultural learning environment, in Proceedings of World Computer Congress: Teleteaching 98, Vienna, Austria/ Budapest, Hungary, August 1988.

Wild, M., & Henderson, L. (1998): "Enculturating On-line learning", *Educational Multimedia and Hypermedia & Educational Telecommunications*, 121-122.

Electronic Commerce in Australia – Trends and Challenges

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Abstract: The growth of electronic commerce (e-commerce) is phenomenon, primarily in the USA. The Australian position in the era of e-commerce is promising and improving rapidly. The digital economy based on globalization and Information Technology is influencing Australian Government to take greater role in shaping blueprint for e-commerce. It is very interesting to note that Australia embraces new technology very quickly. For example, Australia has the 3rd position in the percentage of Internet use just after the USA. As revealed in a recent survey, many potential customers in Australia are reluctant to do business on the Internet due to security concerns on online payment systems. The paper outlines the recent development of e-commerce in Australia and identifies major trends and challenges concerning this online business. The author also provides a snapshot of the current status of e-commerce globally.

1. Introduction

The Internet is driving economic growth at an unprecedented rate in the USA. Australia along with many other western countries is also enjoying the benefit of the explosion of Internet use. It is creating a huge market in cyberspace and carry valuable information to a large number of people all over the globe. Telecommunications technology has turned the world into a global village. The entire world is getting networked. Furthermore, the individuals and organizations will become more and more location-independent for their information needs and performing their roles in the society and economy.

2. The World Wide Web & E-Commerce

With the emergence of the World Wide Web (WWW), totally new global business culture and environment are emerging. The new way of doing business across the globe is called Electronic Commerce (E-Commerce) or Online or Internet Commerce [Roth 1998]. E-commerce is accelerating the growth of digital economy. 'The Age of Networked Intelligence is an age of promise' as predicted by Tapscott [Tapscott 1996]. E-commerce is a technological wonder for benchmarking and productivity improvement [Karmakar 1999]. It helps to achieve greater production and distribution efficiencies. All contemporary production methodologies are dependent upon highly dynamic information flows in supply chains. E-commerce also helps to keep reduced inventory and thus lowering operating costs for the company [Mougayar 1998].

3. Current Status of E-Commerce: a global overview

E-commerce is growing dramatically. It was approximately U$43 billion last year, but it is estimated that online business may sour to U$1.4 trillion by 2003[Los Angeles Times 1999]. It promises to radically redesign business processes to do business in the connected world [Kambil 1997]. E-Commerce still represents a relatively small percentage of the total commerce market, but it is significant and growing exponentially. With the growth in Internet usage, there is a corresponding increase in E-Commerce. The USA is the leader in driving E-commerce due to its dominance on the Internet. Currently over 80% E-Business is taking place in the USA.

Information Technology (IT) is key challenge to the world economies in regards to the network infrastructure and the way in which it is effectively utilised by an economically leading age industries and government to have effective global markets According to a recent report (July 29, 1999) by GartnerGroup[1] – IT spending will increase to $3.3 trillion worldwide by 2002 driven by E-business initiatives. It also predicts that 60% of IT spending and decision-making will originate within business units and away from the traditional IS function. Electronic Commerce will be crucial for IT spending as corporations aspire to thoroughly re-engineer their business processes.

4. E-Commerce and Australia

Australian businesses are moving rapidly to participate in electronic commerce activity-as providers of goods or services The strong growth in the use of e-commerce by Australian consumers could be attributed mainly to the following factors :

- High percentage of Internet use,
- Easy to use,
- Widespread acceptance of credit cards,
- User-friendliness.

Australia's Internet users are expected to be 5.8 million by 2002, according to International Data Corporation [Manktelow 1998]. The most recent data[2] concerning Australian Internet User Population are as follows:

Regular Internet Users (access at least weekly):	1.8 million
Casual Users	1.5 million

There are more male users (68%) than female users (32%). The majority of Internet users live in New South Wales (37%) and Victoria (22%). Internet use varies among age groups - the people from 20 to 39 years are the most frequent users.

Dr. Paul Twomey, the Head of the National Office for the Information Economy (NOIE) in Australia, said billions of dollars could be saved by adopting e-commerce [Lynch 1999]. The priority industry sectors for the impact of e-commerce are banks, communications, government, education, transport, health & professional services. Internet penetration is reaching a point where e-commerce applications like banking and share trading are accelerating quickly (Tebbutt 1999).

Australian Internet Service Providers would be in a strong position to act as supplier hubs for small and medium sized businesses. Australia also has the potential to be an Asia Pacific regional hub due to its strong skills base and high quality telecommunications infrastructure.

The digital economy based on globalization and Information Technology is influencing Australian Government to take greater role in shaping blueprint for e-commerce. Australia's information economy policy, Investing for Growth was released by the Prime Minister, Hon'able John Howard in December 1997. The Government is committed to providing a light-handed regulatory framework to support and encourage the development of electronic commerce.[3]

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[1] http://gartner5.gartnerweb.com/public/static/aboutgg/pressrel/07299e_bus.html

[2] http://www.consult.com.au/reports/aus_internet_user_population.html

5. Trends & Challenges

The Internet and related markets are growing exponentially. Electronic commerce provides consumers with convenient shopping methods, from online catalogue ordering to phone banking, both of which eliminate the costs of expensive retail branches [Kalakota & Whinston 1997]. Electronic commerce is now a valuable business tool to run business in a cost-effective way and thus providing consumers goods at home at a reduced price. Now there is a true convergence of computers, communications businesses. Electronic commerce presents ongoing challenge to the international legal systems. It represents major threats concerning privacy and security. It is a business without a boundary, so concerns are the collection of the sales and other taxes and secured electronic transactions.

Australian trend to e-commerce is exciting. A recent study by GartnerGroup has found that online spending by Australian consumers has reached $US1billion for the first time and will grow to $US7.6 billion within five years [Grayson 1999]. The GartnerGroup research also found that annual business-to-business e-commerce spending had reached $US3.6 billion and would rise to around $US44.8 billion by 2003.[4] This is compared with annual business-to-business e-commerce spending of $US12 billion for the Asia Pacific region in 1999. This was the forecast to explode to $US280 billion by 2003.

Australia is facing a number of challenges. The foremost among them is the shortage of meeting the Digital Workforce. A report recently released by the Australian IT & T industry Skills Taskforce has estimated that around 30,000 additional IT employees will be required over the next 12 months, 88000 over the next three years, and more than 169,000 by 2004. Tertiary institutions are graduating only about 10,000 students annually (Williams, 1999). Most traditional Australian firms do not have a culture of competing on price or of really letting the savings flow through to the consumers. There will be tremendous competition for product markets and firms need to exhibit flexibility to cope with those challenges.

Electronic commerce presents fundamental challenge to the law. The suitable law should tackle the threat of security and privacy when we do business online in the digital economy [Karmakar & Fertuck 1998]. As revealed in a recent survey, many potential customers in Australia are reluctant to do business on the Internet due to security concerns on online payment systems. But for anyone to benefit from E-Commerce, electronic payment mechanisms must be reliable, secure and easy to use [Clarkson 1998].

6. Conclusions

Global information infrastructures are rapidly becoming a reality to run business electronically. Australia can overcome its isolation to take part effectively in electronic commerce. The Web is the key player in bringing e-commerce which will create true network economy. Selling the products of many firms on the Web is growing exponentially. Doing business on the Internet should be easier, fairer, safer and legal. For most end users, the convenience and benefits of electronic commerce will soon outweigh risks, thus giving rise to an Internet commercial explosion [Lane 1998].

7. References

[Clarkson, 1998] Clarkson, N. (1998). "E-Commerce in OZ: Fact and Fallacy," Australian PC World, pp.56-68, September.

[Grayson 1999] Grayson, I. (1999). Australian online spending cracks $1.5bn. The Australian www.news.com.au Tuesday August 24 , p. 34.

[Kalakota and Whinston, 1997] Kalakota, R. and Whinston, A.B. Electronic Commerce: A Manager's Guide. Addison-Wesley

[Kambil 1997] Kambil, A. (1997). Doing Business in the Wired World. Computer, May, 56-61.

[Karmakar & Fertuck] Karmakar, N. L & Fertuck, L. (1998). "Security & Law on the Internet with Australian and Canadian Perspectives," presented at the World Conference of the WWW, Internet, and Intranet (WebNet 98), Orlando, Florida, Nov. 7-12, 1998.

[Karmakar 1999]Karmakar, N. L. (1999). The Art of Managing Information for Benchmarking and Productivity Improvement. Presented at the 'Portland International Conference on Management of Engineering and Technology: Technology & Innovation Management: Setting the Pace for the Third Millennium', Portland, Oregon, July 25-29, 1999. Proceedings Vol-1:PICMET'99(Book of Summaries),pp. 490-491; Proceedings Vol-

[Lane 1998] Lane, R.J. (1998). The Computing Model for the Information Age. In D. Tapscott, A. Lowy & D.Ticoll (Eds). Blueprint to the Digital Economy: Creating Wealth in the era of E-Business. McGraw-Hill, 239- 259.

[Los Angeles Times 1999]. Los Angeles Times, (1999). Microsoft targets e-commerce. The Sydney Morning Herald, p. 67,Saturday, March 6.

[Lynch 1999] Lynch, A. (1999). E-trade to solve billions: Twomey. The Australian www.news.com.au, Tuesday, August 10, p.62.

[Manktelow 1998] Manktelow, N. (1998). China is catching up on Net use. The Australian, November 3, p.42.

[Mougayar 1998] Mougayar, W. (1998). Opening Digital Markets: Battle Plans and Business Strategies for Internet Commerce (2nd ed.). McGraw-Hill

[Roth 1998]Roth, J. The network in Business. In Tapacott etal (editors) Blueprint to the digital economy: creating wealth in the era of E-Business, McGraw-Hill, 1998.

[Tapscott 1996]Tapscott, D. (1996). The Digital Economy: Promise and Peril in the age of Networked Intelligence, McGraw-Hill.

[Tebutt 1999] Tebutt, D. (1999). Online is finally worth banking on. The Australian Internet & E-Commerce: A special report, Tuesday August 3, p. 3.

[Williams 1999] Williams, R. (1999). Unis face skills challenge. The Australian www, news. Com.au, Tuesday, August 10, p.59.

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[3] http://www.law.gov.au/ecommerce/legal.html

[4] http://www.gartner.com

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Abstract, Proposal to Present: Work in Progress, Short Paper, WebNet 99

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Talking Through the Web: Finding Your Voice Online

Do you remember the move Aliens, and the catch phrase was, "In space, no one can hear you scream"? That same horror is invoked in many instructors when they learn that their institution wants them to teach a class online. The fear may grow deeper when they are writing instructors. What about my voice? What about my students' voices? In cyberspace, no one can hear you scream—or otherwise.

As a writing instructor, this was indeed a huge concern of mine when I was faced with teaching an English composition class online. Even though the concept of voice is one we speak of when we are talking about writing skills, it seemed to me that the concept still needed to be vocalized somehow—through lectures, reading out loud, etc. Furthermore, I was scared that my personality in the classroom would be lost in the online forum; and I had always felt that my in-class presence was one of my strongest teaching skills.

The obvious didn't occur to me, though, until well into my first semester of teaching online.

The fact that students (and instructors) are forced to conduct almost all of their communication in writing inherently lends itself to a productive writing class (whether it be creative writing or research writing). The old adage rings true: you can only learn how to write through the very act of writing. This is also true, I found, with the concept of voice.

Whether or not students had previously talked about (or had been lectured on) this concept, after a few weeks, I was able to discern many of their personalities through only their emails and threaded discussion responses. Most of them already knew the concept of voice. They just didn't know that they knew.

I still had quite a time trying to explain this concept to students when it came to more formal types of writing. In informal communication, their voices were often very evident—their writing through email was usually bold, bright, and full of personality! All of a sudden, though, it was gone when I received one of their formal essays. Gone without a hint.

Had this occurred in the traditional classroom, where the bulk of the writing I received was in the form of the more formal research essays, I may never have seen that many of my students' had voices at all. Within the online forum, though, I had other correspondence to show students and say, "Like this! Your voice comes through here..."

What teaching writing online showed me about the concept of voice is that it is not exactly a teachable skill; in fact, it already exists in every writer. The challenge is in trying to teach students to not turn it off. It can be modified as necessary—for the more formal assignments—but formal writing doesn't have to mean boring, faceless writing.

Over the three semesters of instructing a research writing course online, I saw this interesting phenomenon take place repeatedly. We would come to the unit on Voice—which came pretty late in the semester—and when asked, very few students were able to articulate the concept of voice in writing. However, all along, much of their informal correspondence with me and with other students was full of *voice*. Enough so that I felt I could say I knew them, even though I'd never spoken with many of them on the phone or met them face-to-face. That *is* the concept of voice.

But now that I knew about this wonderful, yet hard to describe, occurrence, the question became: how do I incorporate this knowledge into a more effective writing class, both online and in the traditional classroom?

Web-Distributed Change Evaluation and Management

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Abstract: Change evaluation and management deal with the analysis, design and implementation of new versions and variants of engineering systems according to requested changes. New systems should satisfy the requirements of cost-effectiveness, time to market, architectural robustness and other applicable criteria. The international project SACHER delivers a methodology and web-based tools for effective change evaluation and management. Web distribution is supported with dedicated tools and the Integration Layer. New web distribution policies are introduced following a specific node type (A, B, and C nodes) and node service classification. In connection with these functions, the project makes extensive use of XML, XSL and meta-modelling technology.

Model-Based Change Management

Change management is a fundamental part of systems engineering. It deals with the analysis, design and implementation of new versions and variants of engineering systems according to requested changes. The SACHER project [SACHER 1998] uses a model-based approach to change management. The methodology includes the following models: a workflow model for managing the change requests, and a process-and-product model of developing and implementing system changes corresponding to the indicated change requests. The workflow model includes a number of roles such as change request analysts, designers implementers, etc. The process-and-product model includes an artefact part specifying all critical products of the target system development and implementation process, and a traceability part that indicates how the changes propagate between the artefacts and related activities. It is assumed that all artefacts and activities may be distributed among change management and system development environments, which may use different methods and tools. SACHER intends to provide appropriate integration of the resulting distributed change process. There are two basic functions of the change process: change evaluation and change management. Change evaluation provides online assessment of the change requests and the planned alternative system changes. Change management uses the assessments to take appropriate informed decisions about change contracts, applicable change process and about the management of the corresponding system development and implementation. A number of change management criteria may be used in the evaluation including change management cost, time to market, risk, architectural assessment [Bass et al. 1998], etc.

Toolset and Integration Layer

SACHER provides the methodology as well as tools supporting the various roles of change management. The SACHER Toolset, built on a requirement traceability platform, supports the change management functionality. The supported interactive user activities include: process and product modelling, metrics modelling, synchronisation of models, change request editing, change engineering, impact analysis and modelling, impact tuning, etc. The Integration Layer (a part of the Toolset) supports the web distribution by introducing a common data representation for the change management and engineering process [SACHER 1999]. The common data representation is based on a common vocabulary introduced by the methodology and supports the defined models. The representation leaves enough freedom for a very broad variety of change management approaches, e.g., the feature-oriented approach. The representation uses XML for data interchange.

The Integration Layer also includes a number of tools to generate and operate on the change management data. The supported functions include export, import, refresh, and translation between different models and presentation of the data. The data should be representation-conformant. While for operation of the full SACHER Toolset a suitable traceability platform is necessary, a simplified but most often satisfactory presentation of the representation-conformant data can be done with much simpler presentation and, where necessary, translation tools. The presentation tools are based on common XML-sensitive browsers. The translation tools use XML metalevel technology to provide adequate translations between representation-conformant data associated with different change management and engineering models. The presentation tools of SACHER use XSL and can define a broad variety of presentation scenarios for various types of change management processes.

Importance of the Web

The ability to share and co-ordinate data generated in different environments associated with an engineering project (including specialised environments for change procurement, implementation, marketing, etc.) is a critical issue of change evaluation and management. The Web is a suitable media for interchange of such data. Another critical issue is the ability to reuse experience and data assets across different instances of the same process or product type.

Node Types, Services, and Web Distribution

Web distributed change evaluation and management is implemented with three types of user nodes. An advanced change management node (A-node) has full access to SACHER Toolset and the respective traceability platform. It supports advanced change evaluation and management processes. Another type of user node, a browser node (B-node) offers a set of simplified change evaluation and management functions based on presentation and translation facilities of the Integration Layer. The name is connected with the fact that B-nodes run appropriately equipped but otherwise regular XML-sensitive browsers. B-nodes use services provided by A-nodes. Still another type of a user node is the C-node, which, through the use of various XML-sensitive tools (e.g., CASE tools) can produce or consume change-related XML data though it does not cover all the change evaluation and management functions of the B-nodes. In particular, they may need to obtain the translation services from A or B nodes.

In SACHER, web distributed change management is implemented by allocating appropriate types of nodes and establishing a policy of exchanging services between the nodes. The policy should reflect the actual needs and technical capabilities of the nodes. The SACHER approach supports an integrated approach allowing for evaluating the entire change management process. Apart from evaluating and managing changes and the changed systems, it is suitable for performing evaluations and managing web distribution policies, for instance from the viewpoint of their architectural robustness.

Conclusions

The SACHER project delivers a methodology and web-based tools for effective change evaluation and management. New web distribution policies are introduced following a specific node type (A, B, and C nodes) and node service classification. In connection with these functions, the project makes extensive use of XML, XSL and meta-modelling technology.

References

Bass, L., P. Clements, R. Kazman (1998). *Software Architecture in Practice*, Addison-Wesley, 1998.

SACHER (1998). Sensitivity analysis and change management support for evolving requirements. *Project Programme*. SACHER Consortium, Milan.

SACHER (1999). XML/XSL data representation for change management. *SACHER Application Note 11*. SACHER Consortium, Oulu.

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Supporting the Ephemeral

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Abstract: This paper introduces the notion of a *Community of Learners* as a teaching and learning model that addresses the education needs of contemporary society. This model can be used to inform the design of online learning environments, and this is illustrated in the HENRE online environment. HENRE, like most online learning environments, has been designed to support learning in institutionally organised groups, however many of the learning needs of contemporary society may be effectively met through more spontaneous learning communities which emerge through an aggregation of people with shared interests and goals. A technology to support such communities could be developed from the existing HENRE learning environment.

Communities of Learners

The notion of a community of learners encapsulates a socially oriented approach to learning, where collaboration, social knowledge construction and discourse contribute to effective learning [Collins, 1996]. Such approaches are believed by many to be more responsive to the needs of contemporary society [Scardamalia & Berieter, 1997; Brown, Ellery, & Campione, 1996; Rogoff, 1994]. Supporting and facilitating communities of learners within virtual environments has been explored in the HENRE project (http://henre.edfac.usyd.edu.au) with promising outcomes [Lambert, 1999]. However HENRE, like most online learning initiatives, has been concerned with providing opportunities within established educational institutions and its communities of learners have been formed from virtual class mates.

Changes in contemporary society bring into question whether an institutional model of learning is one which will address many the population's emerging learning needs [Twigg, 1994]. Long duration courses may not be effective in a society where the half-life of information is rapidly falling, where workers are involved in increasingly varied tasks, and where specific knowledge may be required quickly. The World Wide Web provides an information medium to meet some of these needs, however richer learning outcomes might be achieved from socially-oriented learning experiences within communities of learners. In accord with this the notion of Spontaneous Learning Communities is presented as model in which ephemeral learning organisations engage in socially-oriented knowledge-building activities.

Spontaneous Learning Communities

Spontaneous learning communities arise organically from a coming together of people with complimentary interests and needs, and while the internet provides the possibilities for this occurrence, it does not currently provide the means to support, in an integrated manner, a rich community of learners in which,

- learners are mutually involved in activities which have brought them together
- a community of discourse is established
- learners own and use the information and knowledge artefacts of the community
- learners are involved in the authentic activities of the community
- learners are able to participate at personally appropriate levels

For such activities to be facilitated and supported requires an environment where community resources can be collected, organised and made widely available, members can interact but maintain privacy if needed, artefacts can be collectively constructed, shared, and published, the community can establish and project a collective identity, and a pervasive communication system supports discourse between individuals and at a whole group level.

In addition to these characteristic, a spontaneous learning community needs mechanisms which support their casual and potentially ephemeral existence. Without organising institutions, for example, learners need effective mechanisms for finding community members, and joining existing communities or forming new ones. Communities need a technological infrastructure which allows for their automatic establishment and eventual disestablishment. In addition, as many people may be members of more than one community they need the means to manage their involvement and access to these communities.

Building on HENRE

The development of such a technological infrastructure could be based on an existing online social learning environment. For example the HENRE learning environment, which provides a non-domain specific collaborative environment for learners, could be enhanced with the functionalities listed above to provide an enabling technology for spontaneous learning communities. HENRE, which has been in use since 1995, has been informed by socially-oriented approaches to learning, and research has shown it to be successful in supporting online communities of learners [Lambert, 1999].

However, HENRE has been designed to support learning communities which are peopled from a pre-defined student population. Typically, these communities are class members concurrently studying the same subject, and as a result, HENRE has no functionalities to enable communities to spontaneously form via mechanisms which aggregate people with shared goals or interests. Internet news groups provide an example of spontaneous communities with effective mechanisms to support their existence, however these communities are not provided with rich collaborative environments that facilitate the socially-oriented activities listed above. In response, the HENRE II project in the Faculty of Education at the University of Sydney is currently exploring the design of a technological model for an extended HENRE which can provide the means to examine the potentials of spontaneous learning communities.

References

Brown, A. L., Ellery, S., & Campione, J. C. (1996). Creating zones of proximal development electronically. In J. G. Greeno & S. Goldman (Eds.), *Thinking practices: A symposium in mathematics and science education*. Hillsdale, NJ: Erlbaum.

Collins, A. (1996). Learning communities: A commentary on papers by Brown, Ellery, and Campione and by Riel. In J. G. Greeno & S. Goldman (Eds.), *Thinking Practices; Maths and Science Learning*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Lambert, P.E. (1999) The HENRE Project: The design and construction of a WWW learning environment. PhD Thesis, University of Sydney.

Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, Culture and Activity, 1*, 209-229.

Scardamalia, M., & Bereiter, C. (1997). Schools as knowledge-building organizations. In S. Strauss (Ed.), *Human development: The Tel Aviv annual workshop: Vol. 7. Development and learning environments*. Norwood, NJ: Ablex.

Twigg, C. A. (1994). The changing definition of learning. *Educom Review, 29(4)*.

How do firms leverage differently a homogeneous physical resource in different industries?

- Using Resource Based View to examine the strategic value of the Web site resource in three industries

Introduction:

Whilst Electronic Commerce has been a hot topic in the press and the consultant literature, the strategic management has not yet examined systematically the strategic value of Web sites. By viewing Web site as a physical resource, this paper intends to respond to the call of Wernerfelt (WERNERFELT 1995) for building Resources Based View (RBV) by advancing our knowledge in 1) mapping the space (or identifying the profile) of specific resources in more detail both in theory and measurement 2) investigating empirically the duality between markets and resources 3) collecting more empirical evidence about how firms leverage differently the homogeneous resource[1]. Aiming to examine Web sites under the light of RBV, we begin this task by asking following two research questions:

If we see Web site as a physical resource to firms, then

1. How differently are firms among various industries exploiting Web sites, an initially homogenous (physical) resource?
2. Do market conditions mediate the strategic value of Web sites? If market conditions do play a mediating role on the value of Web resources, what are the contingencies between market conditions and firm's exploitation of Web resources?

To answer the first questions we use a list of 50 distribution channel functions summarized from previous Channel Distribution, Consumer Behavior and Electronic Commerce literatures to examine the functions of Web sites. To answer the second question, we examine 60 web sites in three industries: travel agent, book sale and the automobile industry to test our hypothesis. These three industries are selected according to Phelan's Internet selling matrix (PHELAN 1996). Our proposition is that the less perceived risk and channel costs of products in a industry, the more functions Web sites in that industry will have. The testable hypothesis is that numbers of functions of Web sites in travel industry, book industry and automobile industry will be descending order.

Results:

Our results partially validate Phelan's internet selling matrix that two market conditions: channel cost and perceived risk do influence the number of the Web site functions but we find discrepancy in the Automobile industry. Our explanation , based on the empirical evidence in this paper, is that the Automobile industry use Web sites also as 'Relation Development' device (contrast previous suggestions of 'cost saving' and 'revenue generating').

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[1] We consider Web sites as homogeneous (physical) resources to firms, in the sense of their technical similarity.

The Academic Implications

(1) Together, the functional list, the industry-wide functions and the unique-industry-wide function can be a tool for mapping Web sites as strategic resources in two levels: within-industry and inter-industries.

(2) The unique-industry-wide functions can be used as the first step for further identifying potential mediating market conditions. As in the case of the automobile industry, the 5 Unique-Industry-Wide Functions related to 'relationship development functions' leads us to hypothesize that the 'value' dimension might mediate the number of functions of Web sites in the automobile industry.

The Managerial Implications

1) This research also has following managerial implications. We propose out functional list can be a cookbook guide for managers in dealing with two issues: 'Web channel design' (i.e., what functions they can put in the Web site) and 'dis/reintermediation' (i.e., what functions be carried out by traditional intermediaries like car dealers) issues.

2) The list of Industry-wide functions can be also a strategic necessity guide for managers in thinking about competitive issues. For example, since these functions represent theoretically functions which can be the most efficiently carried out by Web sites in different industries. For Web-based firms competing on a 'cost strategy', these industry-wide functions represents a basic function they can/or must adopt into their sites to be as efficient as their competitors. On the other hand, for Web-based firms adopting a 'value strategy', they probably need to focus either to do better in these functions or do other functions (to differentiate from these industry-wide functions) to be competitive.

Bibliography:

PHELAN, S. E. (1996). Internet marketing: Is The Emphasis Misplaced. Annual Meeting of the Australian & New Zealand Academy of Management, Wollongon, NSW, Australia.

WERNERFELT, B. (1995). " Resource-Based View of the Firm-ten years after." Strategic Management Journal **16**: 169-170.

Real Instructors Don't Go to Chat Rooms

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Abstract: Using the Web to enhance or as the sole medium for teaching has produced a new range of problems and opportunities. Tools that facilitate such teaching are appearing and enhancing the delivery and activities of these courses. Studies have been made on how readers (usually students) use such material and tools. Systems have been developed that analyze the student profile, adapting both the pages and the navigation. This paper explores the other side of these issues: the perspective from the author (usually an instructor). ReCourse, the Retargetable Course Generation system, has had the instructor as a focus from inception.

Keywords: authoring, adaptive hypertext, dynamic hypertext, web-based course management systems, distance education

1. Introduction

WebReCourse [5], the Retargetable Course Generator enables creation and reuse of Web courses. It is a secure software system for online course management, allowing instructors to increase the accessibility of online course material and to create a convenient means of communication between instructors and students. It provides many of the enhancements missing in the World Wide Web implementation of hypertext.

ReCourse allows an author to write a single document which can dynamically choose its content when a reader selects a particular topic.

We call this *Retargeting*, because the information is retargeted to different readers and different audiences. Such retargeting is a staple among course instructors who teach similar courses to different audiences, or teach the same course multiple times under different circumstances.

Previous papers [6,7] have analyzed student use and response to these tools.

Despite what appears to be an overwhelmingly positive response by students, tools such as ReCourse have not become commonplace in the web-enhanced classroom.. In our experience, instructors either shy away from even trying it, use such tools once and not again (thus, for us, defeating the whole Retargeting philosophy!) or use such tools in such a minimal way as to have little impact on the students.

For us, this was particularly frustrating because of all the similar systems, ReCourse was designed to enhance instructor use. The student tools are fairly standard.

Since we knew these tools are viewed positively by students [6,7], we decided to find out why instructors are not as enthusiastic, and to discover what we can do to encourage them to use web tools to enhance their classes. In particular, we wanted to discover what changes need to be made for effective use. We generalize this to the problem of authoring and using integrated tools for World Wide Web courses.

2. Instructor Assessments

Because we had discovered how useful the tools were for us as instructors, we only waited until we felt the tools were robust enough before making them available to other instructors. A ReCourse "team" consisting of both undergraduates and graduate students prepared to monitor their use. We began with a few carefully selected instructors within the Computer Science Department.

Ultimately, this became two instructors, one teaching an undergraduate course and one teaching a graduate course.

The instructor teaching the graduate course found that entering the class members by hand was quite tedious - he had no TA. Group observation showed that he did use the Grading Sheet, but that there were no postings other than our own on the bulletin board, and no indication that the chat room was ever used. The instructor teaching the undergraduate course had a TA, so only the TA complained about entering the students by hand. Nevertheless, we realized that this must be changed and we changed the ReCourse User function to allow students to enter themselves.

The following term we went outside the computer science department and "invited" a few instructors who, we felt, had positive attitudes towards teaching to try ReCourse. One was reasonably computer literate (he had created his own web pages) while the other found computers generally frustrating and had had her pages created by a school web master who does this as a service to faculty members. We also assigned one member of the ReCourse team to work with each instructor.

Because we had not prepared the same level of questionnaire for instructors as for students, we relied on their feedback both to me and to the ReCourse team member. We are currently testing a new group and changing our questionnaire as well.

We have some clear results, however. We characterize them below:

1. *Faculty Status (!)* When the ReCourse team (students) sent an email invitation to faculty, inviting them to try out and then use the system, there was virtually zero response. When the author (faculty) sent the same message, many people responded.

2. *Faculty Chaos & Inertia* Of those faculty who did respond and declined to use the system, no one had time to even look at it. All mentioned wanting to use it "in the future." All appeared overworked - one mentioned being overwhelmed that term.

3. *Missing functionality* One faculty used it for one term and did not choose to use it again. She wanted a feature not yet available (the grading system does not operate with full spreadsheet features yet).

4. *No instructor help* One factor is that some instructors do not have teaching assistants to help them.

3. Author Characteristics

Although we continue to gather information and statistics, we know the following:

1. The more computer literate an instructor/author is, the more apt they are to use the system, and the more apt they are to use more of the available tools.

2. The more helpful the assigned ReCourse team member is, the more apt the author/instructor is to use the tool in its entirety.

3. Newer faculty are much more apt to respond to the invitation, to use more of the tools, and to return to use it again. This is due to more experienced instructors having (existing, but not as appropriate) tools they are used to using and the general chaos that surrounds faculty members as they find themselves with more service activities. The ReCourse team believes as they hear that the tool is an asset, they will make the (small) effort to use it.

4. Conclusions

ReCourse is documentably popular and useful for web courses. Students like it. But students have grown up in a computer world and, now, even in a web world. Instructor/authors have more inertia. We are continuing to gather statistics from both the users and non-users in an attempt to encourage use of a system which improves the delivery of web courses. It is likely that a new type of education is needed to create the appropriate mindset for using tools for web-enhanced courses.

3D-, Digital Environments for Social Contact in Distance Work

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Abstract: Shared 3D environments are investigated as a means of providing information for supporting awareness and the feeling of co-presence in distance work. The aim of this work-in-progress is to develop work environments for distance work that satisfy both social and ergonomic demands in order to reduce social isolation and stress and increase work efficiency when working at a distance.

Introduction

In traditional workplaces there is continual, mutual awareness of co-workers' activities as well as rich opportunities for informal communication and spontaneous meetings. This contributes both to productivity and to well being because of better coordination of work activities and support of social processes in the workplace. In distance work, however, these dimensions are largely missing, which contributes to social isolation, increased stress and reduced efficiency. The aim of the current project, which is in its initial stage, is to develop work environments for distance work that satisfy both social and ergonomic demands.

Providing Information for Awareness and Co-presence

A basic problem is to identify information that supports awareness [Dourish & Belotti 1992] and co-presence: the feeling of mutual, social presence, of simultaneously being in the same place, and to provide that information so that it does not intrude on foreground tasks, but serves as a background and a context. It must be sufficiently rich, but at the same time not violate privacy. A straightforward approach is to provide open video- and/or sound channels between participants. However, there are a number of disadvantages for continual use, such as high bandwidth requirements and violation of privacy. An opposite approach is to provide symbolic information, e.g., ambientROOM [Ishii et al. 1998]. However, the mapping of information is arbitrary and representations could become too artificial. Both approaches also lack the important notion of a common place. A third possibility, then, that has only recently begun to be investigated for this purpose, e.g., [Broll et. al 1999], is to use a shared 3D-, digital environment (DE) for supporting awareness and co-presence.

3D-, Shared Digital Environments

3D-, shared DEs, which are currently available over the Internet, can provide rich information without the surveillance aspect of desktop video. Rendered, but possibly realistic, avatar representations of participants provide a straightforward mechanism for action filtering, representing only relevant information. Because all participants are represented in the same environment a natural shared space for co-presence as well as for exchanging task-related information is provided. However, unlike most approaches to shared DEs, here the DE is not intended to provide the primary means for task-oriented, focused communication and collaboration, but to be a complement to other means.

Early User Studies

The Active Worlds technology [Active Worlds, 1999] was used for the initial mock-ups. A first informal study took place as part of a course requirement, where students' were building a shared DE for a virtual exhibition and meeting place. A group of three students were working together at a distant location and the tutors' task was to give advice, when requested, by means of the built-in text chat, or by telephone. Initially the tutor, using a 17" screen, experienced problems with screen estate and found the DE intrusive. A portable computer with a 12" screen was then added, placed on the side and used for presenting the DE (fig.1). Students who needed help could simply "walk up" to the tutors' avatar in the DE, filling the tutors' screen with their own avatar.

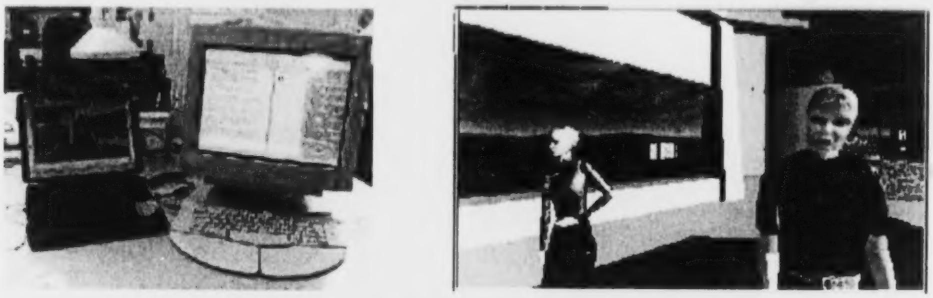

Figure 1: In the picture to the left a prototype workplace setup is shown. The picture to the right shows one participants' view of an interior of a DE with two other participants, represented by personal Avatars.

This type of setup was found to provide a natural, efficient and non-disruptive way of keeping in touch and initiating communication. An informal evaluation showed that the DE induced a strong feeling of co-presence, but that awareness of actual activities at the distant site was lacking, due to limitations of the technology. The same observation was made in another study, where five informal text-chat meetings between three to four participants, and lasting between 15 and 30 minutes, were held in a DE. A short questionnaire was issued to the participants. They all agreed that the feeling of co-presence in the DE was high, but that there was a lack of information in the DE about real-world events.

Future Work

The concept obviously requires an efficient coupling from events in the real world to the DE. Video image analysis and sensors are being investigated for this purpose. A related question concerns avatar design: how should users be represented and what do avatars need to express? A flexible, ergonomic workplace along the lines of the simple prototype shown in fig. 1 is being developed in collaboration with the TCO, using multiple flat-panel displays. Large-scale projections will also be investigated. Long-term user testing with at least three functional prototypes will be performed.

References

ActiveWorlds (1999) http://www.activeworlds.com

Broll, W., Gräther, W.,, Meier, E., Pankoke-Babatz, U. & Prinz, W. (1999) Place People in Context - the Awareness Forum. In Bullinger, H.J. & Ziegler, J. (Eds.): *Human-Computer Interaction: Communication, Cooperation and Application Design. Proceedings of HCI'99*, 2, pp. 462-466

Dourish, P. & Belotti, V. (1992) Awareness and Coordination in Shared Workspaces. In Turner J. & Kraut (Eds.). *Proceedings of CSCW'92*, ACM, pp. 107 - 114.

Ishii, H., Wisneski, C., Brave, S. Dahley, A., Gorbet, M. Ullmer, B. & Yarin, P. (1998). ambientROOM: Integrating Ambient media with Architectural Space. *CHI98 Conference Proceedings*, ACM, pp.173 -174

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Putting Your Course On-line? And Your CBL Skills Are?

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Introduction

The WWW is fast growing as the new medium in academic institutions for organising and delivering subject material to students. This paper focuses on the lack of structure and foresight in preparing and supporting academics in this new teaching environment.

Perceived benefits

The justifications for utilising, where feasible, this new technological learning support (or teaching-aid, depending on perspective) are many. There are of course disadvantages, however due to the continuing enthusiasm in higher education for computer assisted learning/teaching we must assume that the positive aspects of this medium eminently outweigh the negative ones. Staff in institutions of higher learning are therefore being encouraged, and often expected, to give their full support to the development of such methods. While most agree that there are obvious benefits, in practice the reality needs further scrutiny.

The reality

Although during the last decade many initiatives have been launched [2] & [3], the situation in several HE institutions, is to petition *academics* to convert their existing course material into computer supported learning (CSL) sites. Many, of course, feel inadequate in this new environment through lack of relevant training.

Purely from a design point of view can we reasonably expect academics to be skilled sufficiently in developing Web based course material to an acceptable standard? Do we have a standard? More importantly is how effective the site is as a teaching/learning tool. The expertise of our teaching staff is normally in a subject area befitting the school in which they teach. Few have teaching qualifications, (and have therefore not necessarily studied learning styles, etc.), and even fewer have degrees in any form of computer mediated teaching/learning. It appears that some on-line courses, not surprisingly, do not address the phases of the learning process correctly. Although this medium is touted as being highly interactive, the lack of expertise on the part of the developer often hinders interaction and learning.

The required pace of the change, coupled with the lack of skills and training, is understandably dampening staff's enthusiasm for this transition. The task is proving to be stressful for many staff members according to a national survey [7], and without their very positive efforts in this direction the processes and pace of change will be hindered. If everyone is thrown in at the deep end, some will swim, but some will sink. We may well loose some of our most experienced and competent teaching staff without good cause. "Since over 70% of HE Institution expenditure is on staff, there is an axiomatic need to make optimal us of human resources...., academic staff need to be qualified not just in their knowledge domain but also in the skills of teaching". [2]

Consideration for our students

Apart from questioning the skills of our teaching staff, do we as developers need to consider whether these new courses are being properly tested and evaluated before going on-line? If these questions are not being asked, and answered positively, then the quality of our courses must be in question. Are we are using our students as guinea pigs while we "try to get it right?" This is a difficult period of transition however, it is an important area for consideration and should currently be under major scrutiny. My intention is to look into the current practices of other Universities, to assess whether students and teachers feel that the quality of courses are being compromised by the haste for change. Whether all are in favour of change is another issue.

Important practice issues

Firstly, if we are to use academic staff to facilitate the change then we must encourage suitable and willing candidates as developers. At the same time we need to ensure that early adopters are not inadvertently exploited. The staff concerned should be seconded from their normal duties in order to allow them the necessary time to become competent in the use of this new medium. For the efficient development of quality computer supported material, it in essential to identify the specific training requirements. Training should also be undertaken when it is likely to be most effective, i.e. when they are able to continue work on a project. We undoubtedly need the provision of competent and responsive technical staff to support implementation (5). Lastly, but of major importance, is the need to identify evaluation criteria that can provide us with reliable evidence of the effectiveness of these new developments.

The options

An alternative to that of using existing teaching staff alone, is to employ consultant educationalists (experienced in electronic delivery of course material) to work alongside academics in house. Another alternative may be to use external developers such as "Blackboard" [3] & [4].

Some have criticised the use of external sources, and tools such as Lotus Learning Space because of the rigidity in the delivery template. Staff are not convinced that the course material they have developed will not be compromised by the tools and the medium itself.

Conclusion

Attitudes towards current practice need to change swiftly if we to avoid an erosion of standards in courseware during this period of transition. Students will demand quality, they will be paying. We must be confident that we are able to deliver what is expected. Staff and students alike must feel empowered in this new environment if we are to reap the benefits that on-line education has to offer.

References

[1] National Committee of Inquiry into Higher Education. Evidence from the Computers in Teaching Initiative. www.york.ac.uk/inst/ctipsych/Dearing/Dearing.html
[2] National Co-ordination Team: Teaching and Learning Technology Programme.
http://www.ncteam.ac.uk/tltp/
[3] Paul Allen Backs Oxford online learning with $500,000
Computergram Issue 3456, 21 July 1998 http://www.niss.ac.uk/
[4] Blackboard Inc. http://product.blackboard.net/Company/institute.html
[5] IMS background http://imsproject.org/background.html
[6] Learning Styles http://www.dougdean.com/learningstyles/index.cfm
[7] Learning online: Professors slow to pick up tech tricks
http://www.msnbc.com/news/306031.asp
[8] Teachers avoiding the net: Distance learning market
http://www.fwl.org/hyper-discussions/deos-fwl/12030.html
[9] Addressing Student needs: teaching on the Internet (Internet/Web/Online Service Information) Vol. 25, THE journal (Technological Horizons In Education) 30-01-1998

Web Radio Sites: An (Overlooked) Opportunity for Broadcasters

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New technology available from the information superhighway has brought forth the possibility that the radio industry is facing a potential revolution. Technological advances have made Web radio an exciting new development in the industry. What is it now? What can it become?

The present research is designed to provide information regarding the extent of Web radio broadcasting in the U.S., briefly describe the range of content and types of graphic devices currently used by Web radio broadcasters as well as the types of changes Web broadcasters anticipate making, discuss the advantages and opportunities presented when employing this new technology, and warn broadcasters of the lessons learned by those already on the Web.

This research, then, is focused upon the Web radio broadcaster and is guided by the following research questions:

RQ 1. To what extent is Web radio used by radio broadcasters?
RQ 2. What is the range of content offered on radio stations' websites?
RQ 3. What changes in the content of Websites do radio broadcasters plan to implement?
RQ 4. What benefits have broadcasters realized as a result of having a Website?
RQ 5. What problems have radio broadcasters encountered with their Websites?

The present research relied on interview and survey data, and content analysis of websites. The research was conducted in three phases: (1) Station Interviews: In-depth interviews with 19 Web radio broadcasters in Chicago, Los Angeles, Minneapolis, and Phoenix; (2) Station Survey: 419 stations completed a questionnaire about their Web radio experiences; and (3) Radio Station Web Site Coding: We conducted a content analysis of 791 radio station websites.

A general conclusion of this study is that broadcasters are underutilizing the Web and their Web sites. Since studies are beginning to show that people who are using the Internet more are using traditional media less (Arbitron, 1999), broadcasters should seriously look to the Web to capture audience attention – and once captured, to hold it by providing sufficient relevant and interesting material. To do this will require goals, a vision, and a commitment of resources.

The World Wide Web and Teacher Education

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Computers are increasingly being used in educational settings. Are new teachers being adequately prepared to use technology to enhance learning? A review of the literature shows that technology is used more and more in teacher preparation classes. However, there are obstacles that still prevent teacher educators from harnessing the power of educational technology. The author presents lessons that illustrates how technology can be integrated in a course on cultural diversity in education. The lessons allow students to experience a new way of teaching and learning that encourages them to construct their understanding of the world.

Teachers are constantly striving to become more technologically literate. Pepi and Scheurman (1996) state that computer technology has a mystical power to "loosen the grip of tight-fisted board members, help principals to find time to work with teachers, get grant money flowing, bring colleagues to presentations, and imbue college administrators with enthusiasm for projects." (p. 229). However, despite all the advances in technology and its power, many teachers are still not using computers in their classroom. Those educators that use computers, do very little to alter the traditional teacher centered classroom.

The purpose of this paper is to explore how the World Wide Web is used in teacher education programs. What obstacles prevent teacher educators from using technology in the preparation of teachers? A review of the literature will show that technology is being used in teacher education. However, it is also clear that in order for new teachers to begin using technology to enhance learning in their own classrooms, they must experience a different way of teaching that allows them to "construct their own knowledge, acquire new models of teaching, and analyze the teaching and learning process" (Hatfield, 1996, p. 223). This paper will contain a number of lessons that illustrate how the World Wide Web is used in a course on cultural diversity in education.

Examples of Using the World Wide Web for Integrating Technology in Teacher Education

"Sociocultural Analysis of Education" or EDUCATION 500 is a required course in the teaching credential program at Loyola Marymount University. For many of the students, EDUCATION 500 is their first course in their education program. The main purpose of the technology assignments is to explore cultural diversity through the use of technology. Specifically, students will gather information on the World Wide Web and they will use software, such as PowerPoint and ClarisWorks, to present information to the class. The class projects will be used as a starting point for the discussions on the different topics used to explore diversity in educational settings.

Lesson # 1: Exploring Issues of Gender and Lifestyle

This technology activity will be used in the lesson on gender and lifestyle issues. At this point in the course, the students have already learned that culture is more than just ethnicity. At the end of this lesson, the students will know how to use a drawing software. Furthermore, they will learn that gender discrimination is prevalent in schools and sexism and homophobia are harmful to everyone.

Procedure: 1. Provide a brief overview to the class and explain that the microculture that will be discussed today will be gender and lifestyles. 2. Provide a quick demonstration of the drawing program in ClarisWorks. Tell the students that they will be asked to create their own picture using ClarisWorks. Highlight the use of clip art and also show the students how they can cut and paste pictures from the internet. 3. Divide the class into 8 groups. 4. Give the groups the following assignment: Draw a picture showing the characteristics that society has on one of the following groups of people: straight men, straight women, gay men, lesbians. Encourage the students to draw their characters in a setting (such as a workplace, a social gathering, etc.) 5. When the group has finished drawing the pictures, each group will be asked to present their pictures using the projector attached to a computer. The students will be asked to explain the stereotypes that may surface. 6. Connect' the lesson with the reading assignments. Discuss how boys and girls are stereotypes in schools and how teachers treat boys differently from girls. Discuss how homosexuals are typecast in society. How does locking people into gender specific roles hurt all people? Discuss the research that shows how girls are harmed because of the differential treatment they receive in math and science classes.

Lesson # 2: Constructivsm through Technology

This technology activity will be used to learn about Sociocultural theory. The main point of the theory is learning is done through social interaction and not transmission. The lesson also demonstrates why it is important for teachers to see their students' prior knowledge as a resource rather than as a liability. This is an important concept to learn especially when teaching students of culturally diverse backgrounds. Through this lesson, the students will experience the theory in a real lesson. The students will also learn how to use PowerPoint.

Procedure: 1. Provide a brief overview of the lesson. Ask the students to remember that they have just learned the different aspects of culture and we have been stressing that culture affect they way students learn. 2. Divide the class into 6 groups. Ask the students who are experts in PowerPoint to raise their hands. These students should be in separate groups. 3. Provide a brief overview of PowerPoint. Using a pre-formatted disk, demonstrate some of the features of PowerPoint. Highlight how to create new slides, change colors, and animation. Tell the students they each group will make a presentation using PowerPoint and all groups will be required to use animation in their presentations. 4. Tell the students that they will be creating a presentation on an aspect of Sociocultural Theory. The six terms that the class will explore are: Lev Vygotsky, Sociocultural Theory, Schema Theory, Cooperative Learning, Zone of Proximal Development, and Constructivism. Each of these terms will be given to a group in a disk. They will need to perform a search on the web on the term that is given to their groups. 5. Give the students ample time to complete their presentations. Stress to the class that they need to work cooperatively in groups and as a class. If one group finds information that they feel another group should be given, then they should pass on that information. Remind the class that there are PowerPoint experts in the groups and they should rely on these experts to help make the presentations attractive. 6. After the students have created their presentations, ask the groups to present their slide shows. The professor should help the students make the connections between each term in between presentations.

7. At the end of the lesson, the teacher will ask the students to talk about the practical applications of Sociocultural theory to teaching.

REFERENCES

Hatfield, M. M. (1996). Using multimedia in preservice education. Journal of teacher education 47 (3), 223-228.

Northrup, P. T. & Little, W. (1996). Establishing instructional technology benchmarks for teacher preparation programs. Journal of teacher education 47 (3), 213-222.

Pepi, D. & Scheurman, G. (1996). The emperor's new clothes: A critical look at our appetite for computer technology. Journal of teacher education 47 (3), 229-238.

Developing an Integrated Environment for Cooperative Learning

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Abstract

The present paper presents the Learn&Web Project that has the objective of being an integrated environment for the cooperative learning in Internet; a place for the intimacy and the exchange of experiences, where the knowledge can be shared among the peers. The major compromise of Learn&Web is the creation of an on line community, active, reflexive and ready to collaborate within an innovative way so that it becomes an useful, qualitative and adequate educational environment to the Brazilian reality and on a continuous improvement.

Introduction

The Internet with all its technologies on information, communication and cooperation provides great opportunities for the Education. The navigation through the Internet can promote the incidental learning which is quite advisable and useful but it is necessary and feasible to provide an organized environment where the learning process is not submitted to the contingencies of the fortuity. However, how to learn within an organized way not only the curriculum and extracurricular contents but also to develop cognitive meta-skills such as decision making, formulation of hypotheses, analysis, synthesis and evaluation? How to learn to interact, to communicate and to cooperate on distance? How to learn to participate as a contemporaneous citizen of a virtual community in the new Information Society? Some of such questions have already answers. During year 1998, it was developed an experimental and testing site, based on DCL - Distance Cooperative Learning [1] that inspired the actual Learn@Web Project.

Summary Environment Description

Learn&Web is an integrated and opened environment for the cooperative learning and a space for the companionship and exchange of experiences where the knowledges can be shared among the peers in the social-historical-cultural Brazilian content. This environment is a place for the collective and cooperative work based in Vigotsky's social-historical-cultural theory [1], and has some goals: a) to apply the information, communication and cooperative technologies available in the Internet to the process of teaching and learning within a consistent and innovative way for both pedagogical and technological aspects, b) to develop courses on distance supported by the Internet, applying new methodologies of learning that meet different users, c) to create a Brazilian multicultural community whose interest is driven to the segment of the Internet in the Education, d) to create the culture of the collective and cooperative of the learning construction among the environment participants and e) to evaluate the results obtained during this process of teaching and learning. The environment follows a line of action, which concentrates its development in new paradigms addressed to the improvement of the Brazilian educational system. It also provides updating and improvement of first and second grades teachers of the public and private schools network that offers a renovation of curricular contents and pedagogical procedures such as courses of Education on distance and the use of the Internet resources and setting and diffusion of the tech-educational materials for the dichotic planning that support the docent practices linked to cooperative projects.

Conclusions

Learn&Web is presently in the phase of setting up its visual identity and is being as far as possible developed based on the Places Theory [2]. This theory is based in a special metaphor to situate actions and interactions occurred inside an integrated work context. Therefore, each space is constituted by a virtual space parameter that will provide the interaction places. The navigation in the environment is being modeled as a hypertext, however close to the linear with the objective of guaranteeing the participant' self-orientation and to avoid the cognitive overload that normally occurs in sites organized in knob networks. It is expected that Learn&Web opens a differential and innovative space in the Brazilian Educational System to provide a paradigm change as regards the attitude in relation to what is to learn and teach in Internet, to permit the development of a critical and reflexive conscience of the virtual community that will be being formed with the participation of children, young persons and adults, including teachers and to prepare participate citizens subject and transformers to act in the Information Society.

Bibliography

[1] VYGOTSKY, L.S.; Pensamento e Linguagem; Editora Martins Fontes: São Paulo; 1987.
[2] *Site* Teoria dos Locais in http://acsl.cs.uiuc.edu/kaplan/theory; 1998.

Implementing an Automated Real-Time Test of Computers Connected to Both an Intranet and the Internet with PUSH Technology

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Abstract

We have been studying Network Design for the last three years. We have developed an interesting algorithm to development a simulation model of a network. To test the model we developed a real-time test for any network that would allow the algorithm to be implemented and the effects on the network to be evaluated. Thus the simulation model could be compared to the real network. We found that the real-time test not only was able to show that the simulation model worked but it took on a life of it's own. It was able to show problems that the simulation model could not show. Problems caused by the type of hard drive used. Problems caused by the interaction of different applications acting across the Intranet and/or the Internet. The software used to control each workstation was Automate. Automate was invoked by the Automate Enterprise server. Unisyn Corporation developed both products.

Real-Time Testing

The purpose of this testing was to improve the arduous task of real-time testing by the use of new tools and refined methodologies. This testing was a second phase of a previous project, which used real-time testing to validate a network-simulation model. Robert Buchanan, author of The Art of Testing Network Systems, offers ten primary test objectives for a network system, and each with a specific methodology and approach [Buchanam 99]. These testing objectives are *application response time testing*, *application feature/function testing*, *regression* testing, *throughput* testing, *acceptance*, *configuration sizing*, *reliability*, *product evaluation*, *capacity planning*, *bottleneck identification* and *problem isolation*. To learn more about how others are using real-time testing, please see the references. In this paper, we emphasize application response time testing which is probably the most prevalent type of testing. Application response time testing is the measure of how long it takes an application to complete a series of tasks, and best represents network performance from a user's perspective. Tests are run at various loads, with a number of real or emulated users [Buchanam 99].

Real-time tests were preformed at three different locations. Two of the testing sites consisted of thirty-two workstations and one server. The third facility contained twenty-four workstations and one server.

Testing was preformed using scripts that when invoked would automatically run applications including Internet Explorer, an FTP client, Word and Excel. The frequency of application requests was set to a given level but using the scripts the applications were invoked randomly. Also the size of files requested was set to a given range depending on the application selected, but the actual size was selected randomly.

The product that was used to setup the scenarios implemented by each workstation was Automate. Automate is developed by Unisyn Corporation. The product includes a scripting language that is very similar to visual basic. In fact, in the scripting language you can invoke visual basic programs. Automate now allows the script to be pushed to the workstation and invoked, thereby eliminating the need to work at each machine. The only requirement is to install the Automate client on each machine.

The tests executed at the first two locations were used to verify that a general network-simulation model was in fact valid. The tests run at the third location were used specifically to address two issues, first, of which was the growth and increased dependence on the Internet and its impact on network performance. Second, was to better prepare the organization for an enterprise migration from Windows 95 and NT Workstation 4.0 to Windows 2000. As part of that preparation this test was hoped to show if in fact the machines running WIN 95 should be upgraded to WIN 4.0 at this time.

The machines were configured very similarly at all three locations. The biggest difference was the number of workstations evaluated. In the first two locations there were thirty-two workstations whereas at the third location there were only twenty-four workstations. The description of the environment at the third location helps one understand how a test was setup.

Environment setup and Preparation for Testing at John Deere

For this real-time test, twenty-four workstations were used to allow twenty to be available for any given test scenario. The test bed environment was a 10MB 10BASET switched Ethernet subnet. The server and all workstations had processors that were at least 200MHz. The server and workstations all had a minimum of 128 MB of RAM and all were running the TCP/IP protocol. The server was running Windows NT 4.0 and included, IIS (web server), and Perfmon, which was used for performance monitoring. Twelve workstations in the test bed were running Windows 95 and twelve were running Windows NT 4.0 Workstation. Other than the difference in operating systems, each set of twelve workstations had a common software load.

In preparation for testing, a fresh "control" software load was installed onto each set of homogeneous workstations to minimize some of the problems which were encountered during previous testing. Both software loads included the Microsoft Office 97 suite, and Netscape browser (version 4.04). All applications, which are used in these tests, were the same across all of the workstations in the test bed. In addition to the core loads, WinFTP was installed on (copied to) each workstation, as well as the AutoMate client from Unisyn Corporation, which was installed on each workstation for automation scripting. Automation scripts were written for AutoMate in "Saxan Basic" and were edited for each of the different test variations. To aid in the timing of the test all workstations were time synced to the test server

Difficulties encountered

At each location, when the machines were being prepared to run the tests and/or the machines were running the tests, many interesting issues were brought to the surface. A few of these issues were:

- A Server configured with an EIDE hard drive would only support up to fifteen workstations whereas a server configured with a SCSI hard drive would handle thirty-two workstations.
- Windows 95 was more likely to lockup during the testing phase.
- Excel had major problems if two machines tried to access the same document
- Many machines were missing applications
- Hardware frequently was found to be faulty

At the end of testing at each location it was found that the machines were in better working order. Fewer employees complained of problems with the machines after the tests then before the tests.

In summary real-time testing helps show how your network will react under different loads and/or when modifications are made.

We would like to do real-time testing on larger and more diverse networks. The product we are using to run the workstations, Automate Enterprise, has a new version out and many new features that would be useful in running real-time tests. Therefore on the next tests we run we will implement the new version of Automate Enterprise.

References

[Buchanam 99] Buchanam, Robert. "The Art of Testing Network Systems: Ten Network Test Objectives" Netscape World (Sept. 1996), Available on (WWW) http://www.netscapeworld.com/netscapeworld/nw-09-1996/nw-09-testing.html (13 Mar. 1999).

[Brookshaw 96] Brookshaw, Chip. "How We Tested" InfoWorld, v18n24 (Jun 10, 1996): pp. 85, 89.

[Jefferson 96] Jefferson, Steve. "How We Tested" InfoWorld, v18n21 (May. 20, 1996): pp. 84-89.

[Kalyanaraman 99] Kalyanaraman, Shivkumar, and Ken Vastola, and Boleslaw Szymanski. "Network Management and Control Using On-line Collaborative Simulation" Available (WWW) http://networks.ecse.rpi.edu/~olsim/ (13 Mar. 1999).

[Milner 99] Milner, Stuart. "DARPA: Real-time Information Transfer and Networking (RITN)" (May 1998), Available (WWW) http://tang.itd.nrl.navy.mil/code5523/ritn/ (13 Mar. 1999)

[Preiss 99] Preiss, Bruno. "Network-Centric Distributed Discrete-Event Simulation" (WWW) http://mat.gsia.cmu.edu/ORCS/0457.html (13 Mar. 1999).

[Stechay 99] Strechay, Robert. "Network Base-lining: Strategic Networks' Base-lining Services" (May 1998), Available (WWW) http://www.zdnet.com/zdtag/snci/advisory/baselining.html (13 Mar. 1999)

[UNH 99] UNH (University of New Hampshire). "Interoperability Lab: Network Management Testing Service" Available (WWW) http://www.iol.unh.edu/consortiums/netmgt/main.html (13 Mar. 1999).

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Nurses' Use of Online Communication Tools: Critical Indicators of Use

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Abstract Although many factors influence students' use of online tools, nurses face additional deterrents to active participation in online courses. Some factors include the traditional reliance on communicating through clients' charts and careplans, as well as face-to-face dialogue or telephones as primary communication vehicles. Trends have emerged, based on post-RN nursing students' reluctance to use online communication options such as posting narrative comments in threaded discussions or having critical exchanges in real-time forums.

The StFX Post-RN BScN Program

St. Francis Xavier University has offered a part-time baccalaureate nursing degree to registered nurses since 1988, enabling more than 600 nurses to complete degrees while living and working in their own communities. Based on a distance education model that combines local resource centres, audiovisual and supplementary resources, local mentors, and regular toll-free telephone access to course professors, this program ensures that students are supported throughout their educational career and are able to communicate with other students in their local area.

Although the traditional delivery format is print-based, StFX offers a number of core and elective courses for nurses in an online or CD-ROM format. Students may select the delivery format that best meets their needs. Online courses feature synchronous and asynchronous discussion forums, while CD-ROM formats include a link to the web also offering comparable forums. Both digital formats offer rich, non-linear learning environments and intuitive interface design.

St. FX Post-RN Students

Student profiles in the St. Francis Xavier University Post-RN BScN Program reveal a majority of women (97%), who are married (88%), and have dependent children (60%). The majority of students range in age from 25 to 44 (88%). Most students are employed in acute care institutions, with work schedules comprised of a series of 12-hour shifts on a rotational basis. Most students have a minimum of 8-10 years experience in professional nursing practice, and have commenced the Post-RN BScN Program to develop their practice and progress professionally.

Among students enrolled in the Post-RN BScN Program, less than 50% have experience using computers, either in their work or at home. Of those students with experience, only a small percentage would describe themselves as "intermediate" or "high" in terms of computer competency.

The Online Course

Students are accustomed to discussing course topics in local face to face groups, which is comparable to the types of communication occurring in the workplace. They are, however, much more reluctant to communicate using online tools. This trend has been observed since online courses have been available through the BScN Program, and while exceptions occur, silent observation or "lurking" has been prevalent in the past.

Upon interview, students report a number of barriers commonly identified in the literature, which include a lack of computer skills, fear of writing a comment in a public place that has the potential for criticism, and a perceived lack of importance related to overall course evaluation (see Moore & Kearsley, 1996; Haughey & Anderson, 1998; Harasim, Hiltz, Teles, & Turoff, 1997).

In addition, post-RN students cited the following factors as barriers to engaging fully in online communication: 1) limited writing skills, associated with mainly documenting specific points of clinical data rather than narrative or scholarly writing, 2) difficulty accessing threaded discussions due to employment schedules and twelve-hour shifts, 3) lack of access to home computers, related to competing demands for computer access in the family, and 4) small class sizes in online courses intimidated students, resulting in the feeling of close scrutiny and the obligation of having to respond to every comment. In addition, it was observed that the course professor's ability to coordinate interaction and weave previous comments together to stimulate further discourse were critical.

Several strategies have been developed to nurture student participation and develop competency and confidence. The primary strategies that are being implemented include assigning a value to online participation, identifying basic expectations regarding the frequency and quality of participation, coordinating a guest online moderator to facilitate discussion of a specific aspect of course content, creating collaborative assignment which necessitate the online interaction among students, the use of online case studies, establishing the online communication environment as a constructive and supportive place to offers critical opinions, theories, and compare perceptions, and supporting the development of writing skills in students through additional resources and assistive personnel (see Moore & Kearsley, 1996; Harasim, Hiltz, Teles, & Turoff, 1997; Haughey & Anderson, 1998).

Faculty development was identified as a significant issue, resulting in the development of a document guiding initial faculty activities in moderating online courses. Additionally, assistive personnel will be available for technical and course delivery guidance.

These strategies will be implemented Fall 1999 and will be evaluated in early Spring 2000 through the use of focus groups and individuals interviews.

References

Harasim, L., Hiltz, S.R., Teles, L., & Turoff, M. (1997). *Learning networks.* Cambridge, Massachusetts: MIT Press.

Haughey, M. & Anderson, T. (1998). *Networked learning: The pedagogy of the internet.* Montreal: Chenelière/McGraw-Hill.

Moore, M.G. & Kearsley, G. (1996). *Distance education: A systems view.* Belmont, CA: Wadsworth.

The myths and realities of using IT in education: A Hong Kong case report

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Abstract: To maintain its competitive edge, the Hong Kong SAR government has decided to invest heavily on information technology in education. This paper will briefly describe the networking environment in Hong Kong. It will also look at what is being done and what has been neglected.

1. Introduction

Education and information technology has become top priorities in Hong Kong political agenda. Special funds have been set aside for development and deployment of information technology (IT) and IT in education. In 1997, 10 primary and 10 secondary schools were selected and given a huge sum of money for them to set up showcase for using IT so that others can follow. From 1999, each of the 1100 plus school was given a sum of money to set up IT infrastructure, network classrooms and connection to the Internet. It is argued that while the IT infrastructure is essential, it is more important to note that contents, software, IT management and people's mind-sets are indispensable for IT in education to be successfully carried out.

2. IT in education: Myths and Realities

The proliferation of the Internet and the WWW provides new channels and modes of delivery of information, the quality of which, however, varies. The unprecedented speed of information processing poses us with these opportunities: (i) IT itself is a motivator. (ii) IT changes the mode human interacts and increases the intensity of interactions. (iii) IT allows connectivity anywhere and anytime; the boundary of time and space becomes blur. (iv) Information accumulation and spoon-feeding is over and so is the "storage" function of students. (v) Teachers' roles are to guide students in information processing, and help them develop knowledge and wisdom.

3. What the government is doing

3.1 Pilot Schools

In 1997, 10 primary and 10 secondary schools were selected and given a huge sum of money for them to set up show cases for using IT so that others to follow. They have finished spending their money in equipping their schools with leading edge hardware and software.

3.2 Quality Education Fund

The Quality Education Fund (QEF) was set up in 1997 to finance projects for the promotion of quality education in Hong Kong, as a result of the Education Commission Report No.7. HK$5 billion was allocated to provide an effective channel for worthwhile projects from the school education sector to be funded of the following types:

3.3 Teacher Training

Training the 43,000 working force of teachers is a major task the government is to achieve in the next 3 years. Four levels of achievement have been established each having specific targets.

4. What have been neglected

4.1 Establishing an IT Culture

There is a need to demystify the perception that IT means high-tech. It is true that IT uses high-tech; however, using IT does not necessarily involve high-tech. It is important to distinguish between using IT as a tool and IT itself (while IT uses high-tech, using IT does not constitute using high-tech). We are talking about learning ***using*, not *about***, computers. IT-culture necessities people's ability and willingness to extend beyond their physical capacities to acquire information and cope with the vast community beyond space and membership.

4.2 Initiating a re-engineering process

A lot of attention and resources have been put in the network connection and hardware set up. However, there was no re-engineering process to raise the quality of teaching and learning.

4.3 Specific training and support for teachers

We need to help teachers overcome the doubts that IT may replace them and spend time to discuss issues such as (i) How can teachers make good use of IT in teaching? (ii) How to make use of the face-to-face interactions, or are they required any more? (iii) How can we ensure individualised learning? (iv) Internet access is of prime importance but when and how can this be achieved in ALL schools and at home?

4.4 Support for learners/students/parents

Students are still primarily examination oriented. At Grades 5 and 6 students spend most of their time doing repetitive drilling exercise for the Aptitude Test. At Grades 10 and 11 they need to do the O-levels ; after which is a two-year intensive study for the A-level. To allow the greatest extent of "learning", these examinations have to be addressed. Parent participation is another important issue.

5. Conclusion

As Warschauer (1999) pointed out, literacy and language skills are changing in the 21st century. It is not so much a matter of using computers to teach the same things more efficiently, but rather to teach the new kinds of literacy, communication, and language skills needed for success in the 21st century. The bottom line, however, lies in the understanding of both the benefit and the costs of these new learning technologies.

References:

Warschauer, M. (1999) Electronic Literacies: Language, culture and power in on-line education. Mahwah, NJ: Lawrence Erlbaum.

Towards a Walloon Virtual Campus

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Abstract : This "work in progress" paper presents the results of a study conducted in Belgium, proposing the deployment of a virtual campus through a call for tenders selecting SMEs and organizations to be trained and accompanied in the development of their own distributed learning project. From the needs analysis, an important focus on quality all along the process will control the decisions, actions, plans and measures, forcing the regulation and preventing the projects from being too technology centered.

The context

Wallonia, a French speaking region of 3,5 inhabitants located south of Belgium, is presently investing in a wide fiber optic infrastructure along the highways with local loops to private organizations and public institutions. Electronic commerce, tele-business and distance learning are then considered as main issues to generate traffic on the new fibers.

Our study

In this context, in 1998-99, the Walloon Region has asked the Department of Educational Technologies of the University of Liège to conduct a study advising the Walloon stakeholders on the choices and steps to make towards a Walloon Virtual Campus[1].

The study ended in June '99, proposing :

- a common platform for distributed learning respecting the emerging international standards ;
- a strategic plan to unfold an efficient distributed learning system over the whole region in the next 4 years, to start in 1999.

This study and the strategy proposed for 1999-2003 could inspire other regions or countries wanting to develop distributed learning. Its focus on quality will allow an emergence of "examples of good practice", transferable to new contexts.

Deployment

Regional information events including many "hands-on" demonstrations will be organized in order to highlight the added-value of distributed learning. The WebCT platform will serve as common tool for a deployment in two phases from 1999 to 2003 :

- In phase 1, a call for tenders will be launched to select 20 projects to be closely coached. The selection criteria will guarantee the representation of diverse target publics (age, socio-economic origin), types, status and activity sectors of organizations, types of objectives, sizes, main focus and contents of the foreseen services, etc.
  In addition to the variety, those criteria will also largely focus on the quality of the proposed methodology (priority given to activities, problem solving, case studies, dialectics,…), the

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[1] Poumay & al (1999), *Vers un Campus Virtuel Wallon*, Rapport à Technifutur

"demultiplicative" aspects of the new services, the quality and originality of the contents and the motivation of the candidates.
A training, provided half at a distance, both in Technology and in Pedagogy (programs of 70 hours and 90 hours already available), will be offered to two persons in each selected organization. Depending of their quality (criteria to be refined in September'99), the new distributed learning services will be certified by the Walloon Region of Belgium and information on those services will be linked to the Region's Web site ;

- In phase 2, one hundred projects will be coached from 2000 to 2002. The same training will be proposed (but not anymore completely free of charge) and the same quality control applied. We should end up in 2002 with a wide covering of the Region and a quality increase of the available services.

The budget, piloting structure and coaching of those actions have of course been detailed, but, most important, a series of educational models serve as references to the development plan. Funding will be obtained before the end of '99.

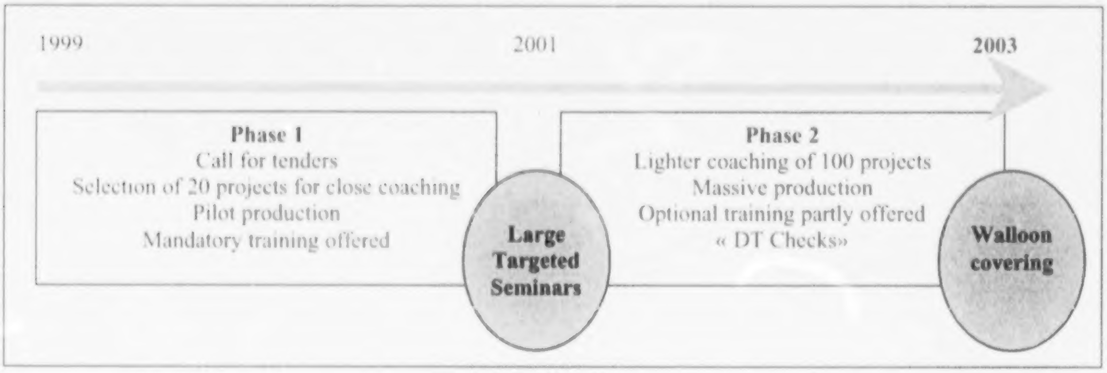
1999
2001
2003
Phase 1
Call for tenders
Selection of 20 projects for close coaching
Pilot production
Mandatory training offered
Large Targeted Seminars
Phase 2
Lighter coaching of 100 projects
Massive production
Optional training partly offered
« DT Checks»
Walloon covering

Figure 1 : Phases of the deployment of distributed learning in Wallonia

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Website Redesign: The long and winding road!

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Abstract: If the Internet is the Information Super-Highway, then redesigning your website has to be the long and winding road! Because the World Wide Web (WWW) has been around for a while now, many sites are on their third, forth and even fifth generation or more. The process of taking a current website and redesigning it (especially on a large site) can be an overwhelming, daunting task. This is the story of one such (painful) experience.

The Integrated Financial Management Program (IFMP) is a very large project currently in motion at the National Aeronautics and Space Administration (NASA). This program will be responsible for overhauling NASA's current financial systems. The Technical and Contracts Office (TACO) is a sub-unit of IFMP responsible for managing the technical work and the main contract associated with the project. One small responsibility also falling on the TACO is the development and maintenance of the IFMP website. When the project started in 1996, there was not a lot of information available, but a website was created in the hopes that it would mature to be a great communication tool, both for project personnel and for the public at large. In the next year, the project started to grow, and with it so did the website. By 1998, the site had been stretched to its limit, and it was time for a change. A great deal of the content was out of date, the user interface was inconsistent, and current web technology was not being used.

This paper will discuss the story of how IFMP went about redesigning their website, the problems and pitfalls they encountered, and the current status of the site. Lessons learned will be shared on do's and don'ts of website redesign for a large site, as well as a look into the hazards of having multiple groups plan and implement a redesign effort.

Introduction

Website redesign. The words invoke a dreaded feeling, one of duplicating effort or worse yet, doing something again while the original still works. Yet, every day, thousands of websites are in the process of being redesigned, costing millions of dollars. Why are these businesses spending all this money doing something to a website that is probably just fine as it is? The answer lies in the fact that the World Wide Web (WWW) is a relatively new technology. As with all new technologies, they evolve. As the web evolves, techniques change and more capability exists all the time. Because of this, companies with websites want to have their best foot forward, thus always wanting the latest capabilities on their website. To accomplish this, those companies need to go through the process of website redesign, taking the information on their current site, and re-mapping it into a newer site, probably consisting of a new user interface, a new look and feel, and possibly new data availability.

Although this re-mapping activity might not sound bad, it can be quite problematic. First, the new website must be laid out and developed. This involves trying to understand who the "customer" or main focus is for the website, and tailoring the site to them. Then a "look and feel" must be created for the target customer. Probably, this involves implementing some of the latest website techniques such as graphic rollovers or JavaScripting. After that, the website must be populated with good data. The old data might or might not fit into the new website, so the team might need to develop new material. Finally, it all has to come together into a nice, neat package that works! If you are lucky, this activity didn't take forever to do, didn't cost an arm and a leg to develop and implement, and the site isn't outdated the minute it is unveiled!

Background

The Integrated Financial Management Program (IFMP) is a large, Agency-wide project currently in motion at the National Aeronautics and Space Administration (NASA). The goal of IFMP is to revamp the Agency's financial systems, providing an integrated approach using the latest technologies and new business practices. The Technical and Contracts Office (TACO) is the part of IFMP which is in charge of monitoring the main contractor for the project, as well as being the head office for technical issues. One of the many activities that the TACO leads is the IFMP website. When the project started out in 1996, there was not a lot of information available about the project, so it was decided that the website would be established, and grow with the project. The initial hope was that the website would serve as source of information and communication for internal project personnel, NASA employees, and the public at large. In the next few years, the project started to grow, and as it did, so did the website. Finally, by 1998, the site had been stretched and stretched to the point of breaking, so it was time for a change. A large amount of content was out of date, and current web technology was not being used. Yes, the dreaded re-design was afoot!

The Redesign Effort

To redesign the IFMP website, a team comprised of multiple entities was created. This included government civil servants and multiple contractors. One of the early decisions made was that the design of the website and the implementation would be split between different contractors. It was hoped that the design team (with its expertise in design) could work on that part of the website, and then hand over the design materials to the implementation team (with its expertise in implementation) to create and maintain the actual site. This is a bad idea because when split, the design team does not take the difficulty to implement the design into consideration. If the design team and implementation teams are comprised of different contractors as they were in this situation, they might use different, non-compatible tools

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which will also make the work slower and more painful. Furthermore, the implementation team will not be able to give as much input into the design, which can also weaken the overall product. Another problem with this approach is that it adds more personnel to the overall project. More opinions get considered, and while that can be a good thing, if there are too many inputs, it is easy to get bogged down coming to a consensus. It is hard to please everyone, and the more people you are trying to please, the harder your job will be.

Next, a schedule was developed to create the necessary graphics to develop a prototype, create the design for the entire site, and then hand over those materials to the implementation team. One big problem was that it wasn't taken into account how difficult it would be to get the content out of project personnel. As stated earlier, the site was full of out of date material. So, in order to populate the new site with useful information, someone or some group had to actively seek out project personnel to retrieve the information necessary to populate the website.

During the design phase, it was also decided that the website should take a three-tier approach to satisfying its customers. In other words, there were three basic groups of people whom the website would cater to. The first group would be project personnel. The second group was the NASA community at large. The third group would be the general public. It was hoped that by creating the appropriate design, the needs of all these groups could be satisfied, eliminating the need for multiple sites. This is a very wise thing to do, because it can save the organization a lot of money. The organization will not have to develop multiple sites for the different groups, and the web team will not have to maintain as many different pages. Furthermore, if the website is designed to please all the people the organization most desires, then clearly the website will be accomplishing its goals.

By July of 1999, 13 months after the start of the website redesign, the site was still not completed. The big thing that was missing was new website content. Although some new content was created, it was still very under populated, and therefore unable to be made public. A decision was made to go ahead with the new site anyway, populating it with old website data until the new data could be developed and placed on the site. This turned out to be a very good idea, because when the new site was released, it made everyone even more anxious to have a well-populated new site, and new content started flowing. Although a schedule was created from the initial project conception, it was not followed very closely. This is a major problem! Although things can happen to throw off schedules, it is very important to try and keep to your schedule, because as long as the schedule slips, more money is being spent on the redesign, and the end goal is delayed.

Current Status

As of September 1999, the IFMP website is in pretty good shape. The site has a considerable amount of new, relevant data, and is organized in an appropriate, helpful manner. The graphics are sharp and attractive, intermixing simplicity and new technology to achieve a modern, classy look. On the horizon for the IFMP website is the development of an area being calling the "virtual office." This will be an area on the website tailored towards helping communication of project personnel. First priority for this area will be a document management system. This system will allow for project personnel to create and store documents on the web. It is hoped that having a virtual office will further enhance the IFMP website, and make it a more useful tool for project personnel.

Lessons Learned

As you might have already known, website redesign is no easy task. Whether you are a small company looking to expand or a large organization with an already huge website wanting a new look, you have a lot of work to do! Although there are a lot of mistakes you can make, here are the key points to keep in mind:

1. Know who your audience is. It is very important to know right from the beginning whom you are redesigning the site for. It is not helpful to think you are designing the site for the general public, and then only have information that is useful to your local project. Likewise, you probably would not put the same kind of look and feel on your site if you are redesigning it for a small organization, than if you were advertising something to the world. If you are trying to accommodate multiple "customers", then you better make sure you consider both needs in the design.
2. Too many cooks spoil the soup! This is true in cooking and it is true in website redesign. The more players you have giving you input, and the more people you have helping make decisions, the more time you will waste, the more money you will spend, and in the end, you will get a site that isn't what anyone wants, and therefore makes no one happy. Although you might need a large team to actually do the work, it is better to have a very small group of people making decisions.
3. Follow your schedule. Create a detailed schedule, monitor it closely, and try to stick to it. It is very easy to get lost or sidetracked in some obscure design issue or implementation feature. Look at the big picture, get the redesign implemented, and touch it up from there.
4. Do not separate the design team and the implementation team. Better yet, have one team that does both. These two facets of development are both very important, and you will find that having experts in one discipline can help with the other discipline and vise-versa. An integrated team will produce a better, cheaper product in less time.

Conclusions

As you have read in this paper, there can be a lot of pain in a website redesign. It doesn't have to go that way – there are a lot of success stories out there as well. If you can avoid the pitfalls and stay focused on what the goal is, you can redesign your website to be a better one. Make sure you focus on your audience. Make sure you use the latest technology with your latest information so you will not have to redesign so soon in the future. Finally, make sure you redesign team doesn't get lost…down the long and winding road!

Integrated Online Learning Environments

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Abstract:

Integrated online learning environments (IOLE's) have emerged with the internet itself. They are based more on a collaborative learning instructional paradigm than the self-instructional paradigm of the multimedia authoring systems and as such, make extensive use of the asynchronous and synchronous collaborative tools available via the internet. IOLE's are client/server applications using standard internet protocols. They have been designed specifically for educational applications. They have taken the stand alone synchronous and asynchronous collaboration capabilities of the internet and integrated them within a tool that mirrors the instructional process.

Because they have been built around the bandwidth limitations of the internet, they do not have the same sophistication of authoring logic built into them as traditional authoring tools. IOLE's are not multimedia development tools although some of them have been developed as enhancements to such tools. They are client/server applications using standard internet protocols. Although some have proprietary client side applications, almost all now have enabled their software to be accessible via common Web browsers.

Given the number of development and delivery tools available to educators to support Internet-based education and the wide variety of approaches to using the internet and WWW for educational purposes, making the right software choices can be a daunting task. Of course there is no one "right" answer. There are simply better or poorer choices based on how well tools are selected to match both organisational and technical requirements.

When organisations embark on a selection process for these types of tools the decision criteria often comes down to getting the tools with the most technical capabilities within some kind of cost or budget limitations. However, software tools can serve different needs just as organisations will have different requirements that need to be met. Educational, organisational and technical considerations need to play a part in the decision.

Education goals can exist at a number of levels. An institution may have an objective to distribute learning via distance education and is looking for a powerful tool with sophisticated administration and user capacity to help them do just that. On the other hand, a single professor may be looking for a tool to support or improve his/her class. These two situations might point to different software tools to meet each goal.

The tools needed for Internet-based, individualized self-instructional modules are different that those that would support a collaborative learning approach requiring high levels of electronic communication between students and instructors. A mixed approach might require a combination of software tools or a product that has the most flexibility to accomodate both approaches to learning.

The technology in place or planned within an organisation will play a large part in the types of development and delivery tools. Institutions with a mix of server and client platforms will place cross-platform versatiltiy high on their list as will institutions wishing to deliver distance education to remote students. Other organisations may have a more homogenized user base which could affect their choice.

Network bandwidth and speed, as well as the power/capability of end user platforms will also play a role. High media content is not well suited to delivery over slow networks with low end PC user platforms.

All organisations have cost and budget limitations. Some of the tools are expensive even though they may be highly appropriate to certain instructional goals. There are low cost alternatives that might meet the same need in a somewhat less integrated way.

Instructional new media development requires expertise. At the very least it requires media creation expertise and should also include professional instructional design support. When organisations do not have this expertise available to them (or have decided not to acquire it), the quality and speed of projects is limited. There are a number of very simple low- end media creation tools available to educators who are "on their own" when it comes to developing Internet-based learning. Professional instructional designers and media developers will need higher end tools.

Another way organisational expertise can affect software selection is simply the preferences and experience of those who are to use the tools. For example, many of the authoring tools are similar in price and functionality, but some multi media developers simply prefer one tool over another or have more experience with one over another. Since the learning curves on some of these tools is high, it often makes sense to stick with what is familiar and effective.

Prioritized organisational needs make wading through technical criteria much easier because it acts as a filter by which to assess the importance of the many features and capabilities of each software tool. Technical evaluation should not be as basic as determining the presence or absence of certain features/capabilties. Two software tools may do the same thing, but one may do it better, more intuitively, faster or more aesthetically than the other. So software evaluations that simply list the presence or absence of features can be deceiving. At the very least, features should be weighted and ranked. Techical criteria should also include measures of usability such as ease of learning, ease of use and flexibility from both an authors and users point of view.

Multimedia authoring tools offer the capability to develop highly modularized and media rich self instruction. Bandwidth limitations of the Internet simply do not yet allow the highly interactive multimedia these same tools can develop for CD-ROM delivery, but that will change soon enough. In the meantime, experiments with browser plug-ins will help define the best use of these authoring environments for Internet based education. The most effective uses of authoring tools for the Internet at this time are for short animations and simple interactive sequences that do not demand much bandwidth, typically embedded in native HTML. Sites that have experimented with this approach have produced easy to use, fast and effective instructional sequences.

The self-instructional model associated with authoring tools break down the "course" structure so common in university education. This model has found greater acceptance in workplace training where more flexible delivery structures are the norm. Many IOLE's are modelled more on the "course" structure found in university and higher education settings. Because they have emerged with the Internet itself, they take better advantage of the collaborative learning possibilities the Internet provides. Many IOLE's cannot accommodate the self-instructional logic that is built in to different authoring systems tools.

The two approaches both have useful pieces to offer Internet-based education. The best solutions will ultimately be some combination of both environments. The importance of bringing a structured instructional design approach to the use of these tools cannot be overstated. All the tools described in this survey can be used to develop very good or very poor instruction via the Internet. The variable that defines quality and instructional effectiveness is instructional design. A much stronger team approach to instructional design involving media experts, instructional design experts, project managers and professors/instructors, than is currently used in higher education, will have to be employed if Internet-based education is going to be a success in the long run.

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Educational WEB Applications integrating multimedia

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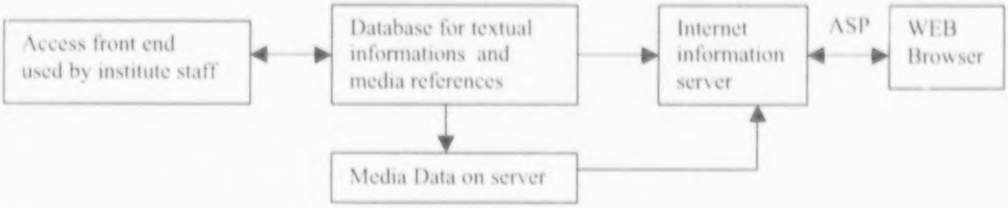
Abstract:
As samples for Web applications we present in this paper a lecture information system and a student learning tool. The technological concept of both is similar. The information is directly published out of a database integrating multimedia data on the fly.

The Multimedia Center was established in November 1998 to moderate and integrate all multimedia activities in the university. Beyond the basic services like media production and running appropiate servers for media streaming and the web it was intented to support the university staff with competent assistance in producing media based materials for lectures and lessons. One of our ongoing tasks is preparing the ground for lectures on demand and the virtual university.

A major amount of these issues is targeted to the web, intranet or public. Therefore we aim to integrate the multimedia based activities and the work of building web applications, where we gathered a lot of experiences in the recent years. Out of our current projects and development we like to pick up two applications. Both can be considered as good examples stressing this goal, having exceptional semantical aspects and different usage scenarios.

They are based on the same technological platform and software. The institute staff responsible for the content is accessing the database by an Microsoft Access front end database application providing forms for data input and update. The Microsoft Access back end database is located on a web-server running IIS 4.0. On server site the databases are accessed and published via ASP (Active Server Pages).


Access front end used by institute staff
Database for textual informations and media references
Internet information server
ASP
WEB Browser
Media Data on server

The first application can be considered as information system containing all lectures, lessons and seminars of the institute of General Practice (see Author 2). Lectures, lessons and seminars can be divided into semantically independent learning units – further on abbreviated as LU - labeled with a theme. To the respective LU the information, when and where it will take place and which teacher will do the task, is linked by using the appropiate form fields of the front end application.

The web application offers several possibilities of publishing the information stored in the database:

List of teachers with phone number, email account, room number etc., list of LUs, weekly time table of all LUs or for a teacher and search forms for LUs, filtered by themes or teachers. For each LU one can get detailled information about time, teacher and content.

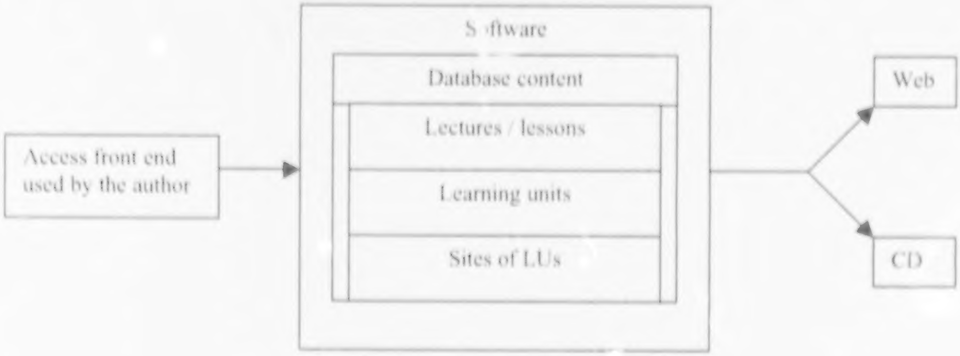
Moreover we added references to the LUs to integrate full text explanations, literature references and multimedia data for the distinct themes of the lessons especially video clips streamed by a Real G2 Server for this purpose.

Starting with a traditional data management tool we expanded this application to a framework hosting multimedia data for lectures and lessons.
As an experiment we added a discussion forum for patient case studies.
The concept and coding of this application was done in consideration of serving as a general template, so that any other institute can use it.

The second application is a web based student learning tool, which was developed in cooperation with the institute of Orthodontics (see Author 3). For each patient test case the staff fill in forms with general data and references to image data. Additonally there can be one or more forms where the correct answers for the questions are filled in, the student has to answer. Each case is assigned a complexity degree. As image data for each case we have jpeg-files for intraoral pictures, models and x-rays so far.
Accessing the application in the internet the student has the choice which question set of complexity degree he wants to work out. Then he can navigate thru the cases, access the image data and zoom them. The questions are presented in HTML-Forms with an embedded rule-driven Java application for marking invalid input. After completing the question forms the student can access an online form comparing his answers with the correct ones.
Again this application can be considered as a general template that can be reused in different fields. Of course one can replace the static images references by video clips.

The first mentioned application you can visit at http://www.med.uni-duesseldorf.de/AllgMed, the second at http://www.med.uni-duesseldorf.de/KieferOrtho.

Strategic concepts and solutions for multimedia based lectures and lessons:
For a university wide software solution we consider the following aspects to be most critical: ease of use, flexibilty, productivity factor and the possibilty of tailoring on costumer's demand. So far we have not found a software on the market really meeting our requirements. So we took the challenge and now we are in the process of developing a solution by ourselves.



Using access forms the author structures his lecture / lesson into LUs containing content sites. Each site is filled with objects like text, interactive buttons, multimedial objects etc. There is a property form for each object type. The software generates the complete html web site with embedded java script and dhtml which is used extensively. Our first tests showed that the generated Web/CD application is capable of playing all known media types by using the appropiate java scripting. The productivity factor on the author site is still a challenge.
For further information about the ongoing process do not hesitate to contact me by email.

Collaborative Knowledge-based Learning Environments and Applications

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Abstract: Our work discusses the prospects of building training systems integrating collaborative and knowledge-based capabilities. We present an example of an educational application build under this capabilities. This application is designed to help in developing procedural skills about OOP in object oriented programming for University and College.

1. Introduction

Many researchers/developers of computer-based instructional systems had considered Intelligent Tutoring Systems (ITS) and Learning Environments (LEs) as different and even contradictory ways of using computers in education. Recent success of such well-known ILE showed that these ways are not contradictory. ITSs are able to control learning adaptively on various levels, but generally do not provide tools to support free exploration. LEs and microwolds support exploratory learning, but they lack the control of an intelligent tutor without such control the student often works inefficiently and may never discover important features of the subject.

Another component that can be added to instructional applications is the collaborative one. This can be defined as the instructional use of small and medium-sized groups through which students work together to improve their results.

Another methodology of approach in computer assisted instruction systems can be used. This consist of three components: learning environment, collaborative / co-operative environment and intelligent tutoring. We present the general structure of such systems and one application designed to help learners in developing procedural skills in object oriented programming.
This educational applications may help teachers and learners in the learning of concepts relayed with OOP, such as instances, abstract classes, inheritance relationships between them, interface and implementations.

In this work, we address the problem of presenting and teaching a general framework where a group of learners may learn concepts relayed with OOP. This paper is organising as follows, the following sections present the characteristics and associated problems with the intelligent and collaboration learning environment components of our educational applications, then present an example of this kind of applications, and our future works. Finally, the last section is the conclusions.

2. Educational applications ´s knowledge-based component

Intelligent Tutoring Systems (ITIs) appeared in middle 70's as a reaction to the limitations of earlier CAI systems. Their idea is to apply AI methods and techniques to CAI systems, yielding the term ICAI (another name for ITSs) **Error! Unknown switch argument.**. Such an integrated system can support the learning of both procedural and declarative knowledge and provide both system-controlled and student-controlled styles of learning.

Our main objective is developing integrated systems can support the learning of procedural knowledge. We understand that training is not the same as teaching or tutoring **Error! Unknown switch argument.**. These differences are important in the design of an architecture for an ITS.

3. Collaborative and learning environment

Collaboration environments support groups of people who work on a common task by providing and interface to a shared environment collaboration support in a interface to a shared environment **Error! Unknown switch**

argument. Collaboration support in a co-operative environment usually requires **Error! Unknown switch argument.**:

- Management of shared data objects
- Management of shared user interfaces
- Support for group awareness
- Support for co-ordination
- Support for communications

Learning environment allows the user to play and experiment with concepts of a given subject. Collaborative tasks reinforce learning. Learners's thoughts may be verified and with answering, discussing and sharing information during a resolution problem process.

Collaboration in computer instructional tools search to provide a framework where the users may develop their own and each other's learning/skills. Collaborative learning methods are more effective that traditional methods.

4. An example of collaborative intelligent environment application

In this work we address the problem of assisting the learner in knowledge acquisition **Error! Unknown switch argument.** and develop of procedimental skills in the building of class hierarchies. So learner may eliminate misconceptions and clarify ideas about this subject.

Class hierarchies is an important concept in any object-oriented programming language. This kind of language and his principles is massively important in today's world.

The developed tool is a complement in methodology to teach concepts as instances, abstract classes, interface and the relationship between them (inheritance and implement). This concepts are presented to learners in the class room by the teacher and then learners can practice in the develop of class hierarchies in a collaborative computer assisted environment. Learners are helped mutually and the communication and discussion is facilitated by the interface application.

Learners do not work alone. They have a virtual trainer-friend that appears to inform and advice about errors or misconceptions are introduced, like multiple inheritance or when erroneous inheritance relationship are defined in the class hierarchy.

5. Conclusions and future works

This tool is part of a more ambitious project that we are developing to introduce and reinforcement relayed with OOP concepts and so learn some bases of any powerful object-oriented programming language.

Our work aims to eliminate spurious concepts of inheritance, to provide a framework where students may '*learn by doing*' and may acquire skills building class hierarchies.

Under the same considerations we are developing more applications. These tools may help to acquire procedural skills in mathematical calculus at University and High School levels.

6. References

Bowen, R. & Savely, R. (1991). *Advanced training systems for the next decade and beyond*. University of Houston-Downtown & NASA Johnson Space Center. Houston. Texas. www.jsc.nasa.gov/icat/docs/NextDecade.html

Bursilovsky, P. & Pesin, L. (1996). *ISIS-Tutor: An Intelligent Learning Environment for CDS/ISIS Users*. University of Trier (Germany), Moscow State University. http://www.contrib.andrew.cmu.edu/~plb/papers.html

Dillenbourg, P., Baker, M., Agnes Blaye & Claire O'Malley (1995). *The evolution of research on Collaborative Learning*. In P. Reimann & H. Spada (Eds). Learning in humans and machines. Towards an interdisciplinary learning science, 189- 211. London: Pergamon.

Flores-Méndez, R. (1997). *Distributed concept mapping collaboration using Java*. Knowledge Science Institute. University of Calgary. http://ksi.cpsc.ucalgary.ca/KAW/KAW96/flores-mendez/KAW96demo.html

Haake, J. & Wang, W. (1998). *Collaboration support in Open Hypermedia Environments*. GMD – German National Research Center for Information Technology. http://www.darmstadt.gmd.de/~haake

Images of Japan – It's Framework and Evaluation

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Abstract:
In the past two years, we have been developing "Images of Japan," a collaborative learning system for Japanese and Japanese culture. We present herewith ways to evaluate its framework and the content along with the results of its experimental evaluation.

1. Introduction

The purpose of a collaborative learning system, "Images of Japan," is to develop a network-based learning environment to promote the interactive learning between Japanese and non-Japanese students. In order to achieve this purpose, the theme of Japanese culture and language is chosen. In determining the specific content, a survey was carried out on a total of 302 Japanese and foreign students at Dokkyo University, Science University of Tokyo and University of Illinois, and over 300 items were collected. The followings are the themes that Japanese students want to introduce, and which most interest the foreign students.

	Japanese	Non-Japanese		Japanese	Non-Japanese
Eating habit and food	51%	25%	Traffic and trains	6%	9%
Sports	12%	14%	Daily lives	36%	32%
Ways of thinking	8%	18%	Music and arts	22%	12%
Religion	5%	37%	Movies and TV	12%	14%
Marriage	1%	1%	Books, hobbies and crafts	35%	35%
Education	5%	14%	Traditional events	26%	12%
Student's life	13%	12%	Geography and region	3%	6%
Language and communication	9%	15%	Nature	7%	3%
Clothing and trains	22%	11%	Others	7%	48%

The diversity of the items selected by the students is far exceeded our expectation. More than 300 items have been collected. The table reveals that there is a wide gap in their perception of Japanese culture, particularly between Japanese and non-Japanese students. We expect that this perceptional gap between the Japanese and foreign students will serve to facilitate a cooperative and collaborative learning and a sharing of knowledge among the students and to lead to their active participation in the program.

2. Evaluation

Other than the number of hits, we believe that the assessment of the web pages can be determined by analyzing the extent to which this perceptional gap among students is filled through the interactive communication on the "Bulletin Board" as well as the content of "e-mails" received by the provider. An evaluation based on those means should be carried out through a long span of time, however. In the meantime, therefore, we have decided to perform an experimental assessment in the form of a questionnaire. The number of responses collected was 63 in total (51 Japanese and 12 foreign students). Questions focus on these themes: (1) The overall frame work, (2) Introduction of the Japanese Cultural items, and (3) Japanese Language Learning Program. The data collected by means of the questionnaire will help us to study necessary changes to be made.

2.1 Framework

The framework of this home page is primarily designed to show the diversity of Japanese society and to encourage users to exchange opinions and to share their knowledge on Japanese culture. In addition to the "Bulletin Board," other devices to evaluate the program are installed. One is a "Voting." Users are encouraged to vote for the items in which they are interested. Users can also add new items of their own choice in the existing page. In the evaluation of the overall framework, the following issues were asked. The responses obtained from those 61 participants are basically positive.

	good	bad
Accessibility of items	78%	22%

	Ver interesting	Interesting	Not interesting
Photo picture	8%	78%	16%

Layout	92%	8%
Linking	98%	2%

Illustration	14%	53%	33%
Animation	20%	68%	12%

	very good	Good	not good	bad
Size of the letter and presentation	12%	80%	6%	2%
Screen presentation	12%	80%	8%	0%
Control of Screen	8%	80%	10%	2%

As for the accessibility of items, however, the response is not sufficiently positive. There could be a few reasons; the list of items introduced may be too many for participants to screen them thoroughly; some students could not see the page because of plug in software, the instructions on how to use the page may be inadequate.

2.2 Japanese cultural items

Each one of these over 300 items is presented with visual and written information. It consists of at least two visual screens either in the form of photos, and/or illustrations, or animations. The written information is the one provided by the students who participated in the original survey.

The responses are not as positive as in the evaluation of the framework, due in part to the lack of sufficient information on each item. Particularly, the responses from Japanese students are much less positive than those from foreign students, while the ones from foreign students are much more positive. Additional comments given by those foreign students are quite favorable; saying, for example, "This is a fascinating resource to learn more about Japanese culture," "I think the items introduced here are very thorough, everything from traditional to modern culture.

		Japanese St.	Foreign St
(1) Could you understand the ways young students grasp Japanese culture?	Yes	76%	100%
(2) Have your ideas towards Japanese culture changed?	Yes	37%	100%

(3) What do you think of this home page on Japanese culture introduced by students?

Japanese students	Useful 55%	Not useful 6%	Interesting 31%	No Answer 8%
Foreign students	Useful 75%	Not useful 0%	Interesting 25%	No answer 0%

2.3 Collaboration

In order to investigate a possibility of encouraging collaboration on this web pages, we asked a few questions such as the one shown below. The response from foreign students is quite affirmative comparing to the one fron Japanese students.

		Japanese St.	Foreign St
(1) Do you want to exchange your ideas with others on the "Bulletin Board?"	Yes	71%	100%

3. Conclusions

The results of the present experimental evaluation suggest that this home page could be a good source of information on Japanese culture and collaboration in general. After implementing further improvements and having obtained sufficient number of responses, we will re-evaluate the home page.

Reference

[1] Tatsuta, Rumi, et.al (1998) "Development of a collaboration system on Internet in order to enhance the understanding of Japanese Culture"

[2] Nakanishi, Yaeko (1998) "Images of Japan" -- "Collaborative Learning System for Japanese and Japanese Culture" Kyohyoh Shogaku Kenkyuh Vol.2-2 Dokkyo University

[3] Murphy, Kare L.(1998) "A Constructivist Look at Interaction and Collaboration via Computer Conferencing" International Jl. of Educational Telecommunications 4 (2/3)

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Universal Ecommerce Currency Breakthrough

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Abstract: The handling methods for money suppress the advancement of Internet business. We need to simplify data processing operations to make more money through E-commerce and appeal to an international customer base. Specifically, we traditionally see money as a numeric field with added currency symbol and punctuation set by language and culture. Rather, a "normalization" of the money structure transforms it into any other world currency, scales its value over time, or adds many currency bases to generate a single total in any chosen basis. One system thus can handle all world currencies at the same time and display them in any chosen formats. This enables one computer system to consolidate assets of different types, unify accounts from the past, present, and future into something that actually makes sense, or sell products or services around the world to people in any country in their own currency particularly over the Internet. In financial and practical terms, this new currency paradigm lowers the costs for multiple currency accounting, centralizes and simplifies work flows, and automates a complex, error-prone, and time-intensive series of steps with a codified method. Although other solutions even current manual or automated methods exist, the paradigm yields economies-of-scale, efficiencies, and accuracy not currently available.

The Monetary Paradigm

Currency is a field variable of a special format. The configuration for a computer system defines exactly what that single property is for each system. It is different for the U.S., for Germany, for China, and for Saudi Arabia. Sometimes, the displays might seem upside down or even backwards. Because of these cultural differences, and because rates to convert currency from one to another float all the time, we see that the Dollar is very different from the Pound, and even alien to the new Euro. We see these currencies as different inventory items; they even have different SKUs or stock keeping units. It is called SWIFT (Society for World-wide Interbank Financial Telecommunications) for designating currency by a three letter designation. This code system is also standardized by ISO 4127 and a three-number code format. The point is that the world's currencies are segregated as different inventory items.

For example, compare $1.00, DM 1,00., 1 FRF, ¥100, £1.00, or

blue, yellow, white, or purple. However, just as colors fit any number of additive, subtractive, or other color models so that they can be compared, combined, or changed into each other, money can be compared, combined, or changed into each other too. Unfortunately for us, political, sovereign, and national pride have created false distinctions. This introduces perverse work flows, computer systems, and other steps reinforcing the differences in money rather than common similarities. Conversion rates are high, the process is awkward at best, and it is not mainstreamed in any way. Even now, banks, governments, and companies in Europe are trying to convert from a single native currency to a new still single native currency over a span of 8 years (5 years have already elapsed).

America and the rest of the world will see this European color change and try to create plaids, stripes, or paisleys too… just to be included. Nevertheless, Europe is only changing one color for another color. The Euro is a political change with functional benefits, but not a functional change. At least, 11 countries will all use the same one color to simplify intra-border business, but the change is barely relevant. The Euro is still another color from the Yen and some 190 other world currencies. This is a small step of legislating fewer colors, but not a substantive effort at creating a universal money wheel, which describes a simple metaphor for unifying how we see currency and other monetary assets, and actually interchange them.

The universal money wheel turns all currencies into a lowest common denominator. In other words, there is a way to reduce all the world's money into the same SKU. There is also a way, it is the same way, to reduce all types of monetarily denominated assets into the same one SKU. That means stocks, bonds, treasury notes, loans (from our point of view), debts, futures contracts, options, hedges, cash in every color of currency, bank accounts in every possible currency, mortgages, complex derivatives, stripped bonds, you name it, can be reduced into the same SKU. Money values from last year, from 1812, from next week, from 01.01.2001 all can be converted into the same SKU. One other convergence, spreadsheets which made What-If? look like the pass key to venture capital money, represents just another feature that is easy reduced into the same SKU. Currency rate conversions and interest or depreciation rates might seem more colorful and real than some hypothetical money conversion with 10% growth in sales volume, but all of these are just artificial displacement shifts from the basic money SKU.

When money is one SKU, change in basis, time, or hypothetical assumptions is a just a shift from that SKU. This means the Yen is another form of the U.S. dollar or the Euro. Blasphemy! We can hold onto prideful national sovereignty issues, but there is no profit in that. Which will it be, blasphemy in these dark ages, or profit from new opportunities?

Did we pick the one SKU? Of course, you are still reading! The table in Figure 1 shows how to restructure currency into a series of set of descriptive properties. Technically, these descriptive properties *objectify* the definition of money and *encapsulate* external meanings; this restructuring of the currency definition is a profound application for object-oriented programming (OOP) concepts. These four listed properties are the minimum for conversion to and from any world currency, handling time-value of money, and presenting the results in any internationalized or localized display presentation. Added optional properties expand the color wheel to support what-if and complexities of derivative monetary assets. There are probably other useful properties that are not obvious yet.

Field	**Name**	**Purpose**
1.	Value	Real "inventory" count of currency, just a raw number
2.	Basis	Description of foreign currency or other monetary basis
3.	Date	Transaction date (and sometimes a millisecond time)
4.	Display	Characteristics for localized/internationalized presentation

Figure 1. Simplified property table for normalized monetary data.

This new color wheel is a structure for money. We still need something to turn the wheel and make Yen into Euro or $1.00 yesterday into Rands next week. That something is big stream of data and an engine that can handle an enormous number of constraints, rules, political declarations, transaction costs, ambiguities, and possibilities for arbitrage. The data requirements include ratios for the relative values of world currencies, interest rates for many periods of time and sizes of transactions, brokerage fees, brokerage arbitrage, and wire transfer fees.

So, we are wondering, how is this paradigm different from the existing foreign currency exchange markets and worldwide bond markets? It is the color wheel metaphor that lets us morph one color into others. The universal money wheel creates a *translatable linkage* and the paradigm infers the necessity for an automated translation engine and the underlying data delivery. Rather than viewing currencies as discrete and inamicable

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entities with equity markets in New York City, Hong Kong, London, and Bremen, we are seeing an interrelated recipe linking all of them with a simple mechanism to convert among all of them. Although the simple flat concept of an *objectified* currency field now has at least four discrete properties, and while that seems more complex that the traditional currency variable, it is conceptually simpler. Instead of 206 world currencies and an infinity of monetarily-valued assets, we now have one unifying SKU with four known, useful properties. The paradigm makes it practical, simple, and unrestrained to implement a currency conversion and translation method for any and all "foreign" currencies and any and all bases for monetarized asset accounting, finance, and risk management. In financial and practical terms, the paradigm lowers the costs for multiple currency accounting, centralizes and simplifies the workflows, and automates a complex, error-prone, and time-intensive series of steps into a codified method. Although other solutions even current manual or automated methods exist, the paradigm yields, economies-of-scale, efficiencies, and accuracy not currently available. For example, while banks, brokerages, even web-based services provide currency conversion rate information, the factoring of monetary values is not automated or performed from a simple embedded rate table. Rates vary by timing, transaction size, negotiation skills of the involved parties, direction of conversion, and posted or hidden fees. This current situation threatens as much as 10% of the transaction in value dissipated through letters of credit (in countries with unstable banking systems) or more typically 1 to 4% in modernized and industrialized nations, still an enormous fee for the honor of converting the monetary basis for normal business transactions.

If there is a pall of gray (or grey, for some of you) over this color scheme, unfortunately we find it in the need for good data and the complexity of translation engine to filter, reduce, and make sense of that data to create useful currency conversion ratios and relevant interest, depreciation, depletion, or amortization rates. However, this part is just a process, method, or apparatus, in the lingo of Berne Convention patent law. No need to worry as there are solutions for that too, technical licensing agreements. What is important, nevertheless, is to see how a new paradigm for something as unassuming and rudimentary, like how we see money, can initiate a transformation in how we do internet-based business in better ways. We can create innovative new markets, and accelerate the ecommerce market into a global, hypercompetitive, and profitable channel. Indeed, the universal money wheel makes it straightforward to create multiple ("multiple" becomes "all" and "simultaneous") currency accounting systems for cash management, internet commerce, offshore bank account reconciliation, and increased integration in procurement or supply chains. The list of possibilities goes on. Here are some examples that are obvious to me, yet barely hint at the possibilities derived from a unified monetary system.

Examples

Any apparent complexity in this currency paradigm underestimates its potential to reform business expectations, integrate workflows, redefine the language of business, and initiate business evolution. The paradigm is practical, shown by these four real world examples.

For example, we can create multidivisional or multi-country corporate 10Q and 10K reports with full currency conversion and rollups in any currency display for printing or automatic Internet delivery. We can use language conversion software to convert the text of the report into other languages too. A French investor evaluating a German corporation might understand the annual report in French with franc evaluations better than in German with deutche mark presentation. We might even consider an added column for euro presentations. Investments and currency fluctuations shown in local currency increases the worldwide desirability of our equities, bonds, and other financial instruments. Consider also all the forms required by government taxing and export agencies, or those provided by banks and brokerages with a mixed bag of currencies; how simple to consolidate to any single currency basis automatically.

For a second example, consider that land in Serbia, Croatia, Kosovo, and Albania is probably very inexpensive right now. These areas are not part of the European Union (EU), but will be rebuilt and modernized out of self-interested necessity by the EU. If land there is denominated in Euros, traded in Euros, building built with Euros, Dollars, or Yen and workers paid in the same bases for example, the liquidity for doing business in those areas is dramatically increased. The Lek, Denar, Dinar, or Kuna are complex to convert or relatively illiquid... if not purely unstable. Gold is complicated, and not conducive to ecommerce, if only from a weight and transport logistic. This war zone create a profitable investment zone if products and services can be exported from those regions within an interchangeable monetary form; certainly not when limited to local illiquid local denominations.

Suppose, as a third example, a divisional buyer at a large automobile manufacturer has the task of acquiring 10 metric tons per month of stainless screws for a new extended passenger SUV vehicle line: starting two years out for a duration of 5 years. This is, in fact, common market auto industry policy for planning, pricing, and manufacturing product. Because the inventory space, cash flow, and lot requirements demand monthly deliveries, the buyer prices acquisition over a period of time factoring the time value of money as well as comparing potential purchases from suppliers in Japan, Taiwan, United States, Sri Lanka, Brazil, and Argentina. Traditionally, bids are denominated in dollars or the country of manufacturer, and the automobile manufacturer will typically split upward or downward intercurrency movements 50/50% with the vendor. This is a primitive hedge tactic that in no way addresses competitive or economic market factors, or seeks to create a sustainable competitive advantage.

Consider a fourth example, a pension fund manager has inflows from government employees for the third quarter in the amount of $39.76 million U.S. dollars to invest. Policy is such that the money must remain liquid for 35 days until the pension fund board of directors meets to vote as to how the funds should be invested long in equities. While short term U.S. Treasuries are providing rates of 3.47%, a capital shortage due to government and economic instability in Indonesia has created government-backed corporate bonds returning 8.95% for interest rate arbitrage. With spot market conversion rates and a 34-day forward option to buy U.S. dollars, the fund manager nearly triples the income during the mandatory holding period just on interest alone. Because the size of the currency trade was so large and value of U.S. dollars so high with respect to the rupiah, in addition, the fund manager has added net 2.7% in hedged currency trades. This yields an overall return of 3.0% for the 34 days, or 32.22% annualized with minimal financial risk (subject only to the political stability of the government of Indonesia).

Conclusion

The practical aspects of this universal color wheel paradigm are its innate support for multiple currency bases, the time value of money, complex financial accounting including equities. We can create new types of multinational derivatives (euro-based debentures for building chip plants in Kosovo, for example), risk management, new planning, process, and operational controls systems, what-if scenarios intrinsically because of the simplified structure. This allows for practical and immediate applications in electronic commerce, banking, brokerage, risk management, financial accounting, and the creation of global derivative products. Support for currency market quotations with bid and ask spreads, complex transactional fee structures, triangulation, rounding, conversion optimization, arbitrage opportunities, and other unexplored potentials are paradigmatically simplified (and made practical) when monetary assets and currencies are universalized. Specifically, conversions to Euro-based accounting can occur at the storage level rather than substituting new software code for every function throughout an application. A "Euro-Fix," therefore, is no longer just a politically necessitated transition but rather a strategic advancement given the intrinsic support for the all other world currencies and monetarized assets at the same time. This new paradigm can usher us past the dark ages with an ecommerce revolution where currency is a universal object in computer systems and information processing.

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QueryDesigner: Simplifying Access to Remote Scientific Databases

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Abstract: Many large-scale scientific data collections are stored in relational databases that use command-line SQL as the query interface. For years, scientists and other occasional users have had a difficult time accessing their data because SQL is terse and unforgiving of errors.

With the advent of the Web browser, forms-based interfaces have been layered on top of relational databases, shielding the end-user from the complexity of SQL. While these interfaces are easy to use, building them requires programming experience. The increasing demand for additional database interfaces is often not met due to declining personnel budgets and a shortage of programming staff.

Our solution was to build a user-oriented tool called QueryDesigner that enables non-computing experts to explore, construct, and personalize query interfaces from a Web browser. QueryDesigner is a Java applet that eliminates the requirement that the interface designer understand SQL, HTML, or any specialized language.

QueryDesigner was built in collaboration with scientists who actually work with large-scale biological databases. It was designed to allow the scientist to easily compose forms-based interfaces that support the way they search databases. QueryDesigner helps the user understand unfamiliar databases by acquiring information on database organization and presenting it as interactive diagram. The applet transparently composes SQL queries, issues requests to a remote database, receives and formats the results.

Scientists Have Special Requirements

Unfortunately, scientists — who are often not computer experts — do not have an easy time retrieving information stored in SQL databases. To formulate an SQL query, the user must first look up the names of tables and fields, which requires the use of a proprietary (non-standard) tool (e.g., Oracle's **sqlplus**). Moreover, SQL itself is terse, error prone, and unfriendly. It is easy to misspell a keyword or data name, omit a "join" clause, or construct a query that returns unintended results [Sme95]. There is also a lack of meaningful feedback during the query process, despite the fact that it is unlikely a casual user will be able to formulate a query correctly on the first attempt [JV85]. The user bears the burden of determining what went wrong, based on cryptic messages that reveal little about the source of the problem.

We were able to capitalize on what we learned about forms- and hypertext-based query interfaces for biological researchers during a previous interdisciplinary project [HNPM95] where we analyzed how users interact with biological databases [New96]. Scientists in the biological disciplines typically begin searches with only a partial idea of where they are going and what kind of results might be available. It is crucial for them to be able to explore the data and investigate the relationships between database entities, without having to formulate complex SQL queries.

With incomplete criteria, a search is likely to return a large result set; most database software simply returns all results in a rapidly scrolling display. Scientists need to be able to determine the size of the results before they are returned, in order to know whether the query needs refining. Support is needed for retrieving results in incremental blocks, paging through them, as well as saving the data in spreadsheet format. Moreover, keyword search is essential in scientific databases because they often contain unstructured data such as field notes or historical annotations.

Another common characteristic of biological data is the inclusion of a large number of attributes; no single organism is likely to contain values for every attribute, so database records contain a large number of empty (or null) data fields. This makes it difficult for users to find pertinent information, since current database management software provides no means of suppressing empty ("NULL") output.

We also found that a number of unsuccessful queries were caused by users' misspelling long scientific names, orthographic and typographic errors in the database itself, or the use of discipline-specific naming variants. When users must type values into empty blanks on a form, specifying search criteria becomes a guessing game. When no results are returned from a query, users are left wondering whether there really is no data available, or if their input was incorrectly specified.

How Query Designer is Used

The QueryDesigner applet (see http://www.nacse.org/qd) employs a graphical interface that permits the end-user to either personalize or create a forms-based query interface to a remote database. The tool eliminates the need for the end-user to learn SQL or proprietary scripting languages. Instead, the user formulates queries implicitly, by specifying on an interactive E-R diagram which data fields should serve as inputs and outputs. QueryDesigner checks to ensure that the joins are legitimate and that all database elements are joined, preventing several of the most common semantic errors. Once the interface elements have been specified, the tool generates an initial query interface, using default rules for placing elements; this can be edited by the user.

In designing a query form, the user can specify whether an input field is to appear blank, pre-initialized to a constant, or shown as a query-list. The query-list feature eliminates user guesswork and spelling mistakes on the query form, by pre-fetching a list of allowed valued from the database. This is particularly useful for scientific databases, given that taxonomic and other scientific names tend to be long and easily misspelled. Although keyword searching is not supported directly by SQL, our software permits the scientist to search for keywords, even when it is not known in advance which fields should be searched.

When submitting a form, QueryDesigner automatically composes an SQL query, establishes a connection to the database, receives the results, and displays them. By default, QueryDesigner automatically suppresses the printing of empty (or NULL) fields to prevent screen clutter. A pull-down is used to limit the number of results returned at a time. A slider at the bottom of the screen permits the user to scroll through results one record at a time. Clicking the SAVE-AS-SPREADSHEET button permits the user to save results in a form accepted by most spreadsheet software.

Finally, QueryDesigner offers advantages in terms of its architecture. Accessible from a Web browser, QueryDesigner is platform independent as well as location-independent of the underlying database. Perhaps the most important advantage is that QueryDesigner is independent of any particular DBMS software. Through JDBC, QueryDesigner supports most relational databases that are addressable over the Internet.

References

[HNPM95] Joe Hanus, Mark Newsome, Cherri Pancake, and Larry Moore. Facilitating access to microbial germplasm through electronic networks. *Proceedings of the 5th International Conference on Pseudomonas syringae Pathovars and Related Pathogens.* Berlin, Germany, September 1995.

[JV85] Matthias Jarke and Yannis Vassiliou. A framework for choosing a database query language. *ACM Computing Surveys*, 17(3):313-340, September 1985.

[New96] Newsome, M. A Browser-based Tool for Designing Query Interfaces to Scientific Databases. Ph.D. Dissertation, Dept. of Computer Science, Oregon State University, 1996.

[Sme95] John B. Smelcer. User errors in database query composition. *International Journal of Human-Computer Studies*, 42:353-381, 1995.

Acknowledgements

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Web-Support for Learning in Finland and Northern Europe

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Abstract: The project, "IT-pedagogy", described in this paper is pursued at the Faculty of Education at Abo Akademi University, Finland in cooperation with other researchers from Finland, Denmark, Greenland, Iceland, Norway and Sweden. The aims of the R&D project are (a) to explore how ICT (Information and Communication Technology, including smart phones and the World Wide Web) can be used to support learning and teaching and (b) to study which teaching methods are best suited for ICT supported learning. Three of its sub-projects -- in vocational, higher and primary/secondary education -- are described. Examples will be shown in the session. The paper also suggests several areas for possible international R&D cooperation.

Aims

The general aim of the R&D project "IT-pedagogy" (www.vasa.abo.fi/itped) is to explore how ICT can be utilized as support of learning in Finland and in Northern Europe, where the sparse population is spread out over vast areas.

Our more specific aims are to cooperate with researchers and teachers in other countries:

1) to find electronic information presented through new media (Internet, WWW, CD-ROM) which is educationally relevant and well structured for learning in primary, secondary and post secondary education,
2) to create some good examples of educational material and ways of examination that support learning (and learning-to-learn) and to publish it on the WWW, CD-ROM and in books,
3) to make this information (1 and 2) easy to find and accessible for students and teachers, and
4) to explore which kinds of learning material, learning strategies and didactic/teaching methods and forms of examination are most helpful when learning is supported by new technology.

Background and Partners

According to the new OECD report, Finland has the fastest growing economy in Europe. It also has the lowest population density in the European Union (EU, 17 persons per km^2). Times Magazine claims that Finland rules when it comes to wireless technology [Murray Buechner, 1999]. Especially well known are the mobile phones produced by NOKIA, the world leader in cell phones. Finland has more cell phones per capita than any other country in the world, more than 60 per 100 inhabitants [Haven 1999, p. 9]. When smart phones (like the Nokia Communicator 9110, www.nokia.com/phones/9110/), are further developed many Finns will soon carry computers with wireless Internet access in their pockets.

Finland has been called "the most wired country in the world", not only because of the mobile phones. In Finland more computers (host) are connected to the Internet than in any other EU country: 88 per 1.000 inhabitants, and more than 18% of Finns aged 15-74 use the Internet daily [Haven 1999, p. 15]. In a new policy document the Ministry of Education [1999] declares the ambition that Finland in the year 2004 is among the top knowledge and interaction societies in the world. The Ministry has offered 300 million FIM per year to develop educational uses of ICT in 1996-2004. That is a lot in a country with 5 million inhabitans.

The five year R&D project (1996-2001) is supported by the Ministry of Education in Finland, the Council of Nordic Ministers and the Swedish Cultural Foundation. The majority of the teachers and researchers who take part in our project are from Denmark, Finland, Greenland, Iceland, Norway and Sweden. We invite partners from other European (and non-European) countries to get in touch to join our international R&D project.

Sub-Projects

1. VocWeb - Vocational Education WWW for Northern Europe:

This is a large web-presentation (www.abo.fi/vocweb) financially supported by the Council of Nordic Ministers during 1996-1999. The main purpose is to produce and organise educational material for students and teachers in vocational education and training. The web-site is created in cooperation with representatives from all Nordic Countries including Iceland and Greenland. The presentation now gives links to and information about vocational education and teacher training in Finland as well as links to Centers of vocational education research in Europe, Australia and the USA. A plan for a course about how to use Internet and the web to support vocational education has been presented by a group of teacher trainers from Iceland, Finland and Denmark [Jeppesen, Mikkonen & Valentin 1999]. It is also important to explore how the Internet can support test administration, which has shown to be useful in vocational education [Knapes et al. 1998].

Suggestions for cooperation: Because of its English parts this presentation can easily be used also by other EU citizens and anybody interested in vocational education and training. We presume that the European Union can be interested to support this project (through the new program for "User Friendly IT") and make it a European matter to incorporate information relevant for vocational education and training in all Europe.

2. HiED - Higher Education Development International

Work on this web site in English (www.abo.fi/hied) begun in 1995 to serve the staff engaged in educational development of college and university teachers in the member states of ICED - International Consortium of Educational Development. The aim is to supply links to colleges, universities and centers for development of higher education. It also serves college teachers and students who want to find new material and strategies for teaching and learning. We now plan to produce a web-based, interactive course in information retrieval. The Ministry of Education in Finland has also decided to invest in an international Internet-university with web-based courses.

Suggestions for cooperation: Updating and further development of this site would be meaningful to pursue in international cooperation. Anybody interested in taking part in the development is invited to write to the author. We want to help future college teachers to learn how to produce web-based course material. However, teachers have to pass several stages of the ten stage process in working the web for education described by March [1999] before they can use the web to support learning and teaching

3. The IT-School - IT for elementary and secondary education

The Ministry of Education in Finland has during the last three years offered financial support to make computers and the Internet useful as tools for learning and to let Finland have the "most wired schools in the world". IT-school is a part of this work and probably the largest among the Swedish speaking minority in Finland, which is spread out over a long coastline and many islands. In Europe – as in the US – there are already web presentations to support teachers in elementary and secondary schools in Europe, as the European SchoolNet (www.en.eun.org) and the Nordic School Net (ODIN, www.odin.dk and www.odin.dk/english/). The aim of IT-school is to serve the schools for the Swedish speaking minority in Finland with multimedia material over the Internet and on CD-ROMs. We study how new technology can be used in support of learning and as tools in the construction of understanding [Lonka, 1997]. We want to help elementary and secondary school students profit from computers and Internet for learning, so they can grow up to live as active and interactive citizens in the "most wired country in the world".

Suggestions for cooperation: A new part of the IT-pedagogy project is to study how ICT can help small isolated rural schools to develop new teaching methods and cooperation. A doctoral student (Gunilla Karlberg, gkarlber@abo.fi) is searching for partners in this project. Most developed countries will soon see youngsters using cellular phones and Internet in schools. It should be a concern for researchers to find out how this modern technology can be used to support learning and motivation to learn, because, as Laurillard [1999, p. 183] puts it, *"there is no point in using communications and information technology ... unless it clearly improves the quality of learning in some way"*

References

Haven, H. (Ed.) (1999). *Education in Finland. Statistics and indicators.* (Education 4). Helsinki: Statistics Finland.

Jeppesen, K., Mikkonen, M. & Valentin, L. (1999). *Yrkeslæreruddannelse og informationsteknologi.* Copenhagen: Danmarks Erhvervspædagogiske Læreruddannelse.

Knapes, J. T., Martinez, L., Ip, C.-F. Slivinski, T. & Hardwicke, S. (1998). Internet-based vs. paper-pencil occupational competency test administration: An equivalency study. *Journal of Vocational Education research, 23*(3), 201-219.

Laurillard, D. (1999). Using communications and information technology effectively. In W. J. McKeachie. *McKeachie's Teaching tips. Strategies, research and theory for college and university teachers.* (10th ed., pp. 183-200). New York: Houghton Mifflin.

Lonka, K. (1997). *Explorations of constructive processes in student learning.* Helsinki: University of Helsinki. Department of Psychology.

March, T. (1999). Ten stages of working the web for education. *MultiMedia Schools, May/June* [On-line serial]. Available WWW: www.infotoday.com/MMSchools/may99/march.htm

Ministry of Education (1999). *Kunskapsstrategi för utbildning och forskning 2000-2004.* Helsingfors: Undervisningsministeriet. Also available WWW: www.minedu.fi/julkaisut/information/svenskaU/i.html

Murray Buechner, M. (1999). Why Your Cell Phone Stinks. Corporate egos and a free market put the U.S. behind the curve--and the Finns. T*ime Magazine 154* (8). Available WWW: www.pathfinder.com/time/magazine/articles/0,3266,29516,00.html

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The Impact of Instructional Design Methodology on Achievement in Alternative Course Delivery Formats: Two Field Evaluations

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Introduction

This paper discusses a work in progress that addresses the potential impact of using four models of learning to inform the instructional design of two university level online courses. We first present each course and the instructional design challenges they pose. We then show how selected learning theories are used to inform redesign of the courses, making them better suited to the online classroom environment. Finally, we discuss how application of these prescriptions enhance the ability to achieve desired learning outcomes and also demonstrate the flexible application of instructional design models in two distinct content areas.

Course I: The Analysis and Design of Business Information Systems

This course has been taught in a place-based format since 1989 and online since 1996. The course contains both conceptual material such as an explanation of roles in a project, steps in a process, and procedural challenges a systems analyst must overcome, and technique-oriented material, such as the drawing of particular types of charts, graphs, exhibits and models. Evaluation of differences between the two different mediums of instruction indicates that there are benefits and difficulties unique to each format. One noted difference is the tendency of the place-based students to express concern about the volume of conceptual information to be learned and discussed in tutorial and in examination settings. The virtual format, in turn, offers a different set of challenges. While students discuss conceptual issues in far more depth than afforded in the place-based setting (Parker & Rossner-Merrill, 1998), they expressed concern about their ability to deal with the required techniques and lacked confidence in their ability to apply them appropriately.

Redesign of the Business Course

A redesign experiment is underway where the virtual seminar takes place within three distinct modes of instruction using prescriptions drawn from cognitive flexibility, problem solving, and dual coding theories. Students will be randomly assigned to each mode. The control group follows the current cognitive flexibility design of the course (Rossner-Merrill, Parker, Mamchur & Chu, 1998). The other two groups will receive identical assignment sets, but these are redesigned in accordance with principles drawn from problem solving and dual coding theories respectively. In the first instance treatment involves a series of increasing challenges for students to solve, thus allowing them to acquire and apply problem solving skills and increased confidence in their ability to do so. In the second instance, text is combined with graphical and audio files to test the format's capability to instil technique-oriented knowledge. Results are recorded in identical assignments, but grades will be normalised within, not across, each mode. The course redesign process will be repeated for the place-based setting in the following term. Based on outcomes from preliminary work, these results are expected:

H1: Cognitive Flexibility (control) will yield highest conceptual scores
H2: Problem Solving will yield the highest confidence scores
H3: Dual Coding will yield the highest technique ability scores
H4: Overall, the virtual group scores on conceptual abilities will remain high as before, but technique abilities will significantly improve. The place-based group scores on technique abilities will remain high as before, but conceptual abilities will significantly improve.

Course II: Introduction to Educational Psychology

In this course students are expected to understand what makes "good thinkers" in terms of how knowledge is understood, used and applied. To this end they study models and theories in educational psychology, how to analyse educational practices and how to develop and defend positions on evaluating educational practices. The course is offered by correspondence and is currently undergoing redesign for adaptation to the online medium of instruction. It is a prerequisite for aspiring or pre-service student teachers who are required to work or volunteer in classroom settings as part of their preparation for formal entry into teacher training or into the classroom setting. Problems posed by the correspondence version of the course are twofold. First, contact with the instructor is limited to two hours per week for all students. Second, opportunities for students to benefit from exposure to expert teachers in ways that prolong and deepen their short experiences of the classroom setting are lacking. Thus advantages to be gained from the mentoring capacity and practical experiences provided by expert teachers are severely curtailed. The online version of the course offers an opportunity to redress these situations and to better prepare aspiring teachers for entry into the teaching training program or into regular classroom placements.

Redesign of the Education Course

Redesign decisions for this course are guided by prescriptions drawn from situated learning theory and related strategies associated with expert mentoring and collaborative learning. As applied, these include revising the Study Guide to reflect and incorporate the interactive nature of online learning, adding a conferencing component to the course, and designing a web site that allows students to access appropriate theoretical and practical knowledge available on the internet. Further, new activities and assignments are designed to maximise and extend students' experiences in classroom settings and to enhance collaborative opportunities to acquire and apply conceptual understanding of educational psychology theories and models of learning. Compared to the correspondence version of the course, we expect that the addition of the virtual format described in the foregoing, will result in the following outcomes:

H1: The extension of expert mentoring to continue in the virtual format will significantly improve students' abilities to analyse educational practices and to develop more effective means to assess their impact on classroom learning.
H2: The addition of web resources, collaborative learning and strategic learning practices will significantly improve students' abilities to understand and apply knowledge gained from the more abstract study of theories and models of learning.

References:

- Parker, D., Rossner-Merrill, V. (1998). *Socialisation of distance education: The web as enabler.* Proceedings of the World Conference of the World Wide Web, Internet and Intranet, AACE, Orlando, Florida.
- Vivian Rossner-Merrill, Drew Parker, Carolyn Mamchur & Stephanie Chu (1998). Using constructivist instructional design featured in two online courses: Notes from the field. *Educational Media International,* 35 (4), December, 1998.
- Phil H. Winne (1999). *Introduction to Education Psychology.* Education 220-3 Study Guide. Faculty of Education and Centre for Distance Education, Simon Fraser University.

Fighting Fire with Fire: Using Web Based Training to Teach Faculty how to Develop Web Based Instruction

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Abstract: Faculty development in the use of web-based instruction is always a challenge. That challenge is multiplied exponentially when those faculty are widely disbursed geographically. Embry Riddle Aeronautical University is unique not only in its aviation emphasis, but also in its world wide educational presence. This paper discusses the efforts being made to use the web to deliver faculty training on how to use the web for instruction.

University Profile

Founded only 22 years after the historic flight at Kitty Hawk, Embry-Riddle Aeronautical University has achieved recognition as a world leader in aviation. Each year thousands of graduates take their place in the aviation/aeorspace industry as pilots, aviation managers, aeorspace engineers, and other aviation professionals.

ERAU is unique not only as a pioneer in aviation, but also as a pioneer in distance education. The University has three campuses: two traditional residential campuses in Daytona Beach, FL and Prescott, AZ and an Extended Campus that is literally worldwide. The Extended Campus offers traditional courses in 125 education centers located around the world and independent study courses to students worldwide.

Instructional Technology Implementation

Because of its importance to aviation, ERAU has placed a high priority on technology implementation. For that reason, faculty members are highly motivated to make use of the web in their classes. Faculty at the residential campuses and Extended Campus education centers use the web to enhance their traditional classes. As such they need to learn how to use the web for everything from posting syllabi to electronic discussions and online testing. The independent studies courses also make use of the web to supplement and replace the traditional paper study guides and video tapes.

The Challenge

Providing faculty with the instructional technology training and support they need to utilize the web in their courses is always a challenge. At ERAU that challenge is multiplied a hundred times plus because of the 125 Extended Campus centers and the two residential campuses. The task of training 3500 faculty members is challenge enough, but when they are disbursed geographically over 127 sites the challenge becomes monumental.

The Traditional Approach

Until recently faculty development on the use of the web for instruction was delivered primarily in the form of a series of traditional face-to-face workshops. The workshops included topics such as browser basics, utilizing web resources, web page design, web authoring, and web publishing. Workshops were offered throughout the academic year, but the most successful implementations were during intensive week long Faculty Technology Camps in the summer months. Although the technology workshops have successfully helped a number of faculty make use of the web, the reality is that the face-to-face workshop approach will never reach even a small proportion of the entire faculty.

The Web Solution

A realization that if the web could be used to provide effective instruction for students, it could also be used to provide effective instruction for faculty was the genesis for beginning to deliver faculty training via the web. In reality, the primordial beginnings of web-based training started with posting some of the handouts used in the face-to-face workshops on the web. As the amount and sophistication of the web materials increased, there was a natural evolution toward web-based training.

The first faculty web-based training module was an overview of web-based instruction named Exploring Web Enhanced Education. The module includes a sampler of web components, a tutorial on incorporating web enhancements, an explorer of web enhancements, and a section on implementing web enhancements. The module is designed as self directed study and is used primarily to provide faculty with an awareness of how they might use the web to enrich their classes.

Additional modules are under development and others are scheduled for the future. A module on web authoring is well underway and a module on web design has been started. The next modules will include the use of templates to publish web pages and multimedia development.

New Challenges

Like most new initiatives, this project has encountered some difficulties. Development of web-based training requires a large commitment of resources. The Educational Technology Team at ERAU consists of three and a half instructional technologists and a graduate student. It has been difficult to reallocate those resources to web development and still maintain the expected service levels that had already been established. A reprioritization of services shifted some resource allocation, but the most productive solution has been a consistent focus on utilization of the web. In the past development of workshop materials was paper based. Today materials and instructional elements are primarily web based. Many of the workshops already have enough web-based components to make conversion to total online delivery a much less daunting task.

Another solution was to outsource some of the development, a solution with its own set of accompanying problems. The first challenge was to find competent developers. That task was accomplished by offering a free workshop on the use of WebCT to interested developers. The workshop provided an opportunity to assess the developers' skills and to establish development expectations for them. While the workshop helped identify good developers, outsourced projects do require significant oversight and management.

The Future

The first steps in using the web to teach how to use the web show great promise for meeting ERAU's unique faculty development issues. It is anticipated that further implementation will provide all faculty members with effective web instruction.

Summary

Web-based training holds great promise in addressing the unique faculty development challenges at ERAU. The evolution from face-to-face workshops to web modules is underway. That process is being accomplished by converting existing paper-based materials to web components and outsourcing development of other web components.

Using Multimedia in Distance Teaching

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Abstract: This paper describes our initial experiences in Computer Based Distance Teaching development. We have studied the application of multimedia of hipermedia in a networked environment. We have also studied languages such as Java language for developing interfaces. As final product, we have developed a mathematics course for high-school teachers.

Keywords : Distance teaching, model of course, network, multimedia.

1. Introduction

Brazil, as many other underdeveloped countries, presents huge socio-economic discrepancies. The investments in education are usually scarce and often mishandled, contributing to increase both the poverty and the inequality of welth distribution. Besides that, Brazil is a country of continental dimensions, with vast cultural and social diversity among its regions. Distance learning may be a key aspect to reduce some of these deficiencies and to promote the education from the basic level to the superior level and also to increase the specialization and professional modernization of a country with these characteristics.

This work presents the fundamentals of a distance learning project. The project has been developed at Goiás Federal University, in Brazil, and its major objective is to create a model for implementing distance learning courses with an intuitive interface. These courses must also help the teachers on their practical activities, providing direct access to sophisticated multimedia resources, without forcing them to know the details of modern WWW based languages. Moreover, there should be means of assessing the students.

2. Objectives

a) Creation of a Model of Course

The main objective ofthis project is the creation of a model for distance courses, using computing resources. This model should specify the main characteristics of user interfaces, tools and techniques of multimedia creation and advanced resources of programming that should be used for the setting up each course.

We propose a generic model that should support the needs of the different contents and disciplines that can be taught at distance. It is important to validate this model with a practical case study, taking into account all aspects of the reality to be modeled.

b) Implementation of the Model

The validation of the model will be performed via the creation of a prototype for teaching a mathematics course at distance, using multimedia resources and the Internet. Once again it is important to make it clear that this practical setting up aims to validate the proposed model through a concrete example. In this case, we chose the context of recycling public high-school maths teachers.

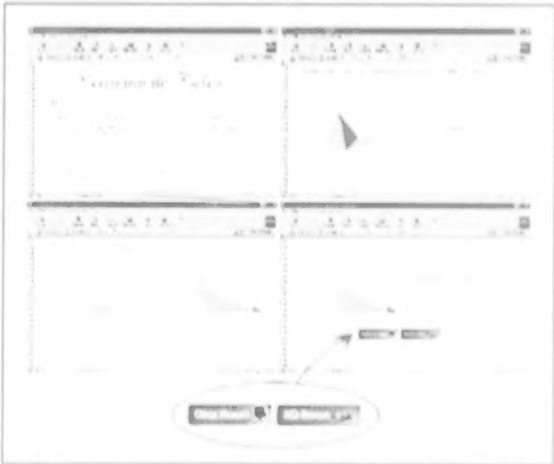

Figure 1: Traditional explanation

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3. Prototype

As an application of some of the multimedia resources, we have created a simple model to teach the Theorem of Tales. In this example, the user interface was designed to simulate the notion of a notebook, something very familiar to the students (Figure1).

In the first part, the contents of the subject were exposed in the traditional form, that is, a textual explanation and some related images. After this, we have created two alternative techniques for reviewing the subject: Cine Room (Figure 2) and 3D Room.

In Cine Room we have used Shockwave resources in order to create a kind of video class, where the subject is explained in the animation form. To facilitate a larger interaction between the student and the presented subject, we implemented a remote control device, allowing the student to control the animation.

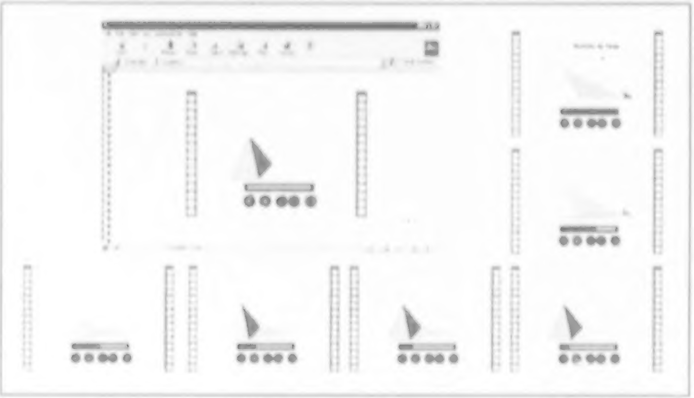

Figure 2: Cine Room

In the 3D Room the student has the opportunity to navigate in a non-immersive virtual reality around the model that represents the presented subject. This allows the student to visualize and to understand the problem from different perspectives.

We also have a Chat Room, where students and teachers have the opportunity to propose questions and to clear up doubts. This model is geared towards the requirement of simplicity that the user interface of a learning system must provide.

4. Conclusion

Distance learning provides techniques and means that allows the students to understand the importance of their roles in the learning process. It places the student in the position of active subject of its own formation and leaves to the teacher the role of facilitator of this process.

Comparing to traditional systems of teaching, there is a considerable reduction of costs, envolving the elimination of expenses from students and teachers deslocations, and the availability in places of difficult access, eliminating the need for deslocation from the work place to look for complementary formation. Considering these processes in scale, it overcomes the high costs of the initial investments to implement a distance learning system.

Although it presents many advantages, we are aware that the distance learning is not a panacea to correct all the educational problems. It cannot, in any way, substitute the traditional education, and neither it can complement all the defficiences of this educational system. Distance Learning is an important piece of the educational process, and it should always be considered in this holistic context.

Our project is a cell that will compose an entire system of development of applications related to distance learning systems. With the implementation of more projects of this type, within governmental or private organizations, we intend to disseminate the search for solutions and for the improvement of the education in our country, guaranteeing, therefore, a better life condition to our people.

6. Acknolegements:

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CONSIDERATIONS TO KEEP IN MIND FOR THE EVOLUTION OF A MULTI-AGENT SYSTEM

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Abstract

Some aspects of an organization may be model with Multi-Agent systems (MAS) [Ucr96], specially those that require workgroups. Due to the dynamic nature of an organization, an MAS may evolve because of the changes that appear in the organization in which it is found, changes in the system itself (inclusion or exclusion of agents, new knowledge, renewal and/or update of system policies) , among others. This paper discuses some of the considerations that have to be kept in mind for the additions the system must have related to functionality, control, communication and knowledge to make the MAS flexible and capable to respond to the organizations dynamics. The coordination role becomes very important for the before mentioned aspects. For the modeling and specification of the MAS coordination, the YUBARTA model was used [Car98].

Key words

Coordination, Multi-Agent Systems, YUBARTA model, GroupWare, Evolution

Introduction

The YUBARTA model is a system made of a set of modules or entities logically intelligent and independent called "agents". Each one has knowledge, about one or more areas, that makes them capable to deduce new knowledge and to answer questions or solve problems related to those areas. Also, working as a group, these entities have the ability to solve more complex problems. In other words, they are able to communicate at a high level: cooperation, coordination and negotiation to execute actions and solve conflicts; control to if they are getting closer or not to a solution of a problem, among others. Cooperative environments formed by a set of intelligent entities that interact with each other to find the solution for a problem, can be modeled and specified. The gathering of these agents make the multi-agent system (MAS); All their characteristics and those of the agents are better studied in [Ucr96].

Functionality, knowledge, control and communication are part of the agent's architecture (See figure 1). The homogeneity on ontology is very important, because with this there is no need for a translator or for an interpreter of knowledge and concepts between the model's agents, even if their knowledge representation differs [Ucr96].

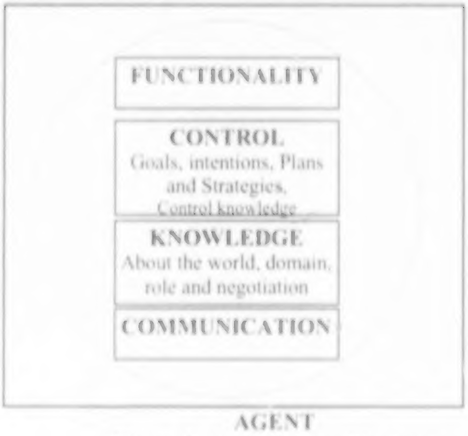
FUNCTIONALITY
CONTROL
Goals, intentions, Plans and Strategies, Control knowledge
KNOWLEDGE
About the world, domain, role and negotiation
COMMUNICATION
AGENT

Figure 1: An agent's architecture

In this paper each one of the changes that may occur in the system's evolution and its effects in the MAS is described. This evolution is proposed from the YUBARTA model [Ucr96], that more than a model is a tool for modeling and specifying cooperative systems; it offers, both, a mechanism for abstract workgroup representation (the model) and a formal language to specify the dynamics of the represented system.

Conclusions

When the conditions in which an MAS was design change, the need for it to evolve is imminent. For such a job, is necessary a coordination job, because there must be one in charge of making the evolution as effective and efficient as possible, and check other's labor (coordinator – coordinated scheme). Whatever the change may be, it will affect every agent's architecture, due to the constant communication between the system members. Changes and evolution spread, and it is in that point that lot of care must be taken to take advantage of communicating to learn from other's experience and to consult external sources when no agent knows what to do or how to carry out new tasks resulting from the evolution. Furthermore, all the agents must be ready to learn and know how to communicate new knowledge, along with knowing how to reuse the acquired knowledge of previous processes (experience).

It is worth to mention that this evolution may be easily implemented, because in [Car98] there is a complete and detailed specification. In general, it may be applied to any MAS, and specially those needing a strong coordinating labor. If there is no coordination because of lack of it or because there is no need for it, an agent may take these concepts and evolve with no need of a coordinating agent.

References

[Car98] Carrillo, A. 1997. *Coordinación de Sistemas Multi-agentes aplicado a Auditoria de Sistemas de una Organización*. Tesis Magister en Sistemas y Computación. Universidad de Los Andes.

[Searle] Searle, John R. Speech acts : an essays in the philosophy of language Searle, John R. Intencionalidad : Un ensayo en la filosofia de la mente

[Ucr96] Ucrós Maria Eugenia; 1996. *SEI: Sistema de Investigación Cooperativa bajo la Perspectiva del Modelo YUBARTA*. Tesis Magister en Sistemas y Computación, Universidad de Los Andes.

Web Applications as a Framework
For
Information Engineering Technology Education

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Abstract: Due to their integrative nature, we advocate that Web applications can provide a unifying framework to the course offerings of the Information Engineering Technology program at the University of Cincinnati's OMI-College of Applied Science. We believe that Web applications can provide *a solid foundation* for IET education since several IT technologies can be taught within such a framework, including: *Programming, Database, Multimedia, Networking,* and *Client-Server Systems concepts.* Web applications can also be used for the development of Senior Design Projects as well. That in turn will enable IET students in acquiring the advanced technical IT skills that are highly sought after by their future IT employers.

1. Introduction

A fundamental change is taking place in the economic structure of developed countries. Information technologies and the Internet have radically changed the way companies conduct business and the way organizations, governments and educational institutions strive to accomplish their respective missions. This has led to a rapid increase in the demand for skilled Information Technology (IT) professionals that are capable of integrating a variety of information and multimedia technologies in support of advanced software applications [ITAA 98]. Such demand, however, has not been met by a matching supply of workers [DOC 98].

2. Motivation

To help meet this demand, the University of Cincinnati's OMI-College of Applied Science (OCAS) has developed the Information Engineering Technology (IET) program to increase the pool of qualified IT workers for the State of Ohio and the nation [Uskov&Saad 98]. The program leads to the Bachelor of Science (BS) degree in IET and offers students the opportunity to master several information technologies prior to joining the workforce, in addition to a solid general education background and practical real-world experience via cooperative education (co-op) placements in industry. The program supports a "2+2+2" seamless transition for students from their junior year in high school, through an associate of applied science degree at the Community College level, or at the University of Cincinnati (UC), and onto the IET program to obtain their BS degree. A recent grant award by the National Science Foundation (May 1999) provides support for an Advanced Technological Education project that will enable us in transforming the IET program into a national model for IT education. The goals of this project titled *"An Evolving Program to Prepare Information Technologists in Southwest Ohio for the 21st Century"* include [Saad&Uskov 99]:

1. Evolutionary and progressive course and curriculum development that is competency-based, using the recently finalized (July 99) IT Competency Profile for the State of Ohio (available online at www.itWorks-Ohio.org).
2. Faculty development workshops to update the IT skills of instructors and faculty at all educational levels.
3. Industrial co-op opportunities at local and regional IT businesses for all IET students.

3. Why Web Applications?

In order to achieve the objectives of our ATE project, it has become imperative to provide a more comprehensive vision for the course offerings of the IET program for the three following reasons:

1. *Faculty perspective:* Our goal is for a better integration of all IET courses leading to a whole (the IET curriculum) that is much more valuable than the sum of its parts (individual IET courses).
2. *Student perspective:* IET students, therefore, would be the primary beneficiaries of this curricular integration.
3. *IT Employer Perspective:* IT businesses and companies are looking for highly skilled IT workers that not only possess valuable hands-on skills with a variety IT technologies, but that can also see *the big picture* of a given IT application being integrative in nature, comprising various software and hardware modules.

Thus a comprehensive vision for all IET course offerings would call upon using an *applied system-oriented approach* that can support the desired course integration. It therefore became obvious that Web applications can provide us with the framework we need to integrate IET course offerings for the following five reasons:

1. *Web applications are typically client-server applications:* Web applications can therefore be used as the vehicle to introduce students to the theory and practice behind the development of client-server systems.
2. *Web applications involve a significant amount of programming,* whether HTML, a scripting language, or a compiled language. A Web application can therefore be used to teach programming at all levels.
3. *Web applications can incorporate the use of a database:* Many web sites currently store information in databases that are dynamically accessible through active server pages.
4. *Web applications typically incorporate the use of multimedia:* Web sites have evolved dramatically over the last three years, moving away from pure textual information to a rich content format that incorporates audio, graphics, animation, as well as streamlined audio and video.
5. *Web applications are typically networked applications:* Connecting a web application to the Internet cannot occur without the connectivity provided by local and wide area networks. Therefore, teaching the theory and practice of networking can be taught in the context of supporting the deployment of client-server Web-based applications that not only integrate a database, but also multimedia features that may require special networking software and/or hardware.

These five aspects of Web applications provide *a solid foundation* for IET education since several IT technologies can be taught within such a framework, such as:

- *Programming:* Object-Oriented Programming, Event-Driven Programming and structured programming.
- *Database:* Databases and database management systems.
- *Multimedia:* tools to create graphics, animation, sounds/audio and video.
- *Networking:* Local Area Networking and Wide Area Networking.
- *Client-Server Systems:* Tools to create Web-based client-server systems.

4. Web Applications as the Basis for Senior Design Projects

In addition to providing a framework for all IET course offerings, Web applications are increasingly becoming the topic of Senior Design Projects of IET students. Senior Design projects that are currently under development fall in two distinct categories:

1. Projects in support of business applications: several student projects under this category are Web applications that are of relevance to a local IT company or organization.
2. Projects in support of educational applications: projects that fall under this category will enable the faculty of our department to offer Web courses in support of the College's Distance Education Objectives.

In summary, we believe that Web applications can not only provide a unifying framework to the course offerings of the IET program, but also for the vast majority of the Senior Design Projects as well. That in turn will enable IET students in acquiring the advanced technical IT skills that are highly sought after by their future IT employers.

5. References

[ITAA 98] ITAA and Virginia Tech (1998). Help Wanted: A Call for Collaborative Action for the New Millennium.
[DOC 98] U.S. Department of Commerce, Office of Technology Policy (January 1998). America's New Deficit, an Update.
[Saad&Uskov 99] A. Saad and V. Uskov (1999). An Advanced Technological Education Project to Prepare Information Technologists for the 21st Century. 1999 Frontiers in Education Conference, San Juan, Puerto Rico.
[Uskov&Saad 98] V. Uskov, A. Saad, and M. Uskova (1998). New Degree Program on Information Engineering Technology at the University of Cincinnati with Distance Education Component. 1998 Frontiers in Education Conference, Tempe, AZ.

Building a Web-based Organizational Learning and Information Support System (OLISS)

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Abstract: This is an in-progress short paper on the development of a Web-based Organizational Learning and Information Support System (OLISS). Designed for users with different levels of knowledge and with a variety of functions within a government agency, our OLISS application has six major capabilities: 1) online reference materials, 2) search, 3) communication, 4) instruction, 5) decision support, and 6) knowledge management. In this short paper, we discuss the features of these capabilities and the methodology we used to identify and evaluate the usefulness of the features.

In this in-progress short paper, we describe the development of a Web-based Organizational Learning and Information Support System (OLISS) that serves a diverse group of users for a wide variety of purposes. Designed for a government agency, the system is developed to support the application of "standard" business policies and practices across the organization. The system provides "just in time" capabilities for users of the system to apply these standard business policies and practices within the ongoing context of their everyday work. Users come to the system from different jobs, experience levels in their jobs, and knowledge of the standard business policies and practices. All the capabilities, in one form or another, provide not only a mechanism for individual learning but also a means for capturing and disseminating newly created knowledge in the organization.

In Figure 1, shown below, we list the major capabilities of the system and the categories of end-users. End-users of the system are *Members*, *Managers*, and *Customers*. Members are members of the organization and are directly responsible for correctly applying the business policies and practices on an everyday basis. Managers are supervisors of the members that apply the policies and practices but managers do not use them as part of their own daily work. Managers are, however, responsible for the correct application of the policies and practices by the members of the organization that they supervise. Customers take possession of the products that result from the application of the policies and practices by the members of the organization. Customers have a vested interest in the correct application of these policies and practices since it affects the quality of the product that they receive.

The capabilities of the OLISS system were designed with the diversity of end-user groups in terms of their function within the organization (Member, Manager, Customer) and their different knowledge levels in mind. A checkmark in the intersection between the row of a capability and the column of an end-user category indicates that it is a capability designed for that type of end-user. For example, in the second row of the reference materials capability, related materials, there is a checkmark in the category Members and no checkmarks for the categories of Managers or Customers. This means that Members of the organization will probably use related materials but Managers and Customers will probably not use that capability. Managers and Customers will probably get all the reference documentation that they require by accessing the procedure & policy documentation on the Web site.

In our case study, having online *reference materials* is an important capability. As Figure 1 shows, all users will benefit from easy access to online documentation describing the policies and practices. Organizational Members, however, will also benefit from easy access and cross-reference of related online materials. It will help them to ensure that the application of the policies and practices are consistent with the other regulations that they must follow. Managers and Customers do not benefit as much from access to these related materials.

Capabilities	**End-User Groups**		
	Members	**Managers**	**Customers**
Reference Materials			
Procedure & Policy Documentation	√	√	√
Related Materials	√		
Search (Free Form Text)	√	√	√
Communication			
Points of Contact (e-mail)	√	√	
Threaded Discussion	√		
Frequently Asked Questions	√		
Instruction			
Instructor Led (Synchronous)	√		
Stand Alone (Asynchronous)	√	√	√
Decision Support			
Guided Search for Policies & Practices	√	√	√
Guidance in Completing Policies & Practices	√		
Knowledge Management			
Case Studies	√		
Real Life Examples	√	√	

Figure 1. Capabilities of a Web-based Organizational Learning and Information Support System (OLISS)

As shown in Figure 1, the *Search* capability provides an important service to the end-users of the Web site. It allows a free-form text search where end-users can type in keywords or phrases and return references to all the pages on the site that match the search criteria. It provides quick access to materials that relate to specific topics.

The *Communication* capability of our case study has four features. The first one is a "points of contact" e-mail feature -- allowing users to contact experts within a subject area. The second one is a "Q and A" feature that allows users to post questions on a listserv. The third feature provides a means to collect frequently asked questions into a FAQ list. The fourth feature is a threaded discussion list that allows users to follow the discussion of only those issues that concern them.

Instruction is an important capability in the design of our OLISS Web site. In Figure 1, we see that members of the organization will benefit from all the instruction that is available -- instructor led and stand-alone. The instructor led feature provides members an opportunity to ask questions concerning specific details relating to the application of the policies and practices. Managers and customers, however, can meet their needs with stand-alone instruction.

The *Decision Support* capability has two types of features. The first one provides for a guided search for the policies and practices. The second feature provides guidance in the completion of the steps for a policy or practice.

The *Knowledge Management* capability of the OLISS has two types of features. One is a means to capture and disseminate case studies. Case studies are general examples that illustrate the correct application of a policy or practice. Many times case studies are used for instruction. The other feature provides for the capture and dissemination of examples that show the correct application of policies and practices in the field. Using these two features, the knowledge management capability allows the capture and sharing of new knowledge -- concerning the application of the policies and practices -- as it is created in the organization.

We developed this list of capabilities through numerous interviews, meetings, and an analysis of the current training materials for the business policies and practices. We designed a prototype system with these capabilities that is currently undergoing an evaluation study. We plan to use the results of the study to finalize the requirements of the completed system by identifying the most useful features for the projected end-users.

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Increasing the Adoption of Online Teaching by Modelling Good Practice

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Abstract: An ever increasing number of academic staff are interested in online teaching. It has been found that staff are likely to benefit by actively experiencing online skills as a learner and that those who have positive experiences and have adequate support are more likely to integrate technology into their own teaching. Nevertheless, staff development activities, at least in Australian universities, still clearly favour 'traditional' methods. This paper examines the integration and modelling of effective online teaching strategies within a staff development program aimed at mainstreaming web-based teaching at the University of Western Sydney.

For a variety of reasons, large numbers of academic staff are taking an interest in adding web-based or online teaching to their repertoire. However, even with incentives and a willingness to change, teachers often retreat back to comfortable, more traditional teaching methods. There is often a discrepancy between 'espoused theory' made up of governing values and actual 'theory-in-use' [Zuber-Skerritt, 1992]. Even those who provide professional development exhibit this tendency - a recent study into staff development activities in Australian universities, related to online teaching, found that traditional modes of presentation were still clearly favoured over online methods [Ellis, O'Reilly, & Debreceny, 1998].

One of the problems associated with traditional staff development activities is that they tend to attract the same people – usually the best teachers [Zuber-Skerritt, 1992]. Some staff may be reluctant to attend as they feel it may demonstrate a deficiency. Many more probably fail to attend simply due to time pressures. Providing staff development modules online not only models good practice, but also provides the advantages we so readily espouse for our own students. It allows staff to work at their own convenience, in private if they wish, set their own pace and target their 'just in time' needs.

While the simple process of moving content onto the Web provides increased availability of resources, many of the major benefits in online teaching are related to totally new teaching methods such as the moderation of discussion groups. Effective online teaching involves more than transferring successful face-to-face strategies. There is a significant need for staff development in web-based teaching and it is desirable that staff become comfortable with online strategies as learners themselves [Freeman, 1997; Wills et al., 1997].

Interest in this area arose from the initial success of PlatformWeb, a web-based teaching environment developed at USWM. A large number of staff, many who would not be considered 'innovators', are now trialling online teaching. Most software systems are developer-based and require the user to adapt to the system. The success of PlatformWeb is due, in large part, to using an adopter-based approach to design, which allows the system to adapt to the needs of the users. One of the key factors in this approach, modelled on Burkman's theory of user-oriented instructional development [Surry & Farquhar, 1997], is to provide significant post-adoption support.

As part of the user-centered approach a survey of academic staff at UWSM was conducted [Hansen et al., 1999]. It was found that concerns regarding traditional teaching delivery could be grouped into three main areas - general administration problems; general and specific communication to/from students; student attitudes and study habits. It is interesting to note that none of the respondents mentioned a possible fourth area of deficiency

– that of the teaching itself? With regard to moving to web-based teaching delivery concerns also fell into three categories – developing and learning web technology; use of existing material and resources; technology issues. By addressing these issues and continually developing the PlatformWeb environment based on user responses large numbers of staff are moving material onto the Web. Nevertheless, without sufficient post-adoption support it is likely that the bulk of users will drop the innovation as quickly as they moved on.

The staff development program associated with PlatformWeb does not adopt an 'all-or-none' approach with respect to delivery. It is made up of many traditional components, such as workshops and seminars, in addition to the online component which seeks to model best practice. The Web-based section contains benefits, problems, strategies, examples, issues and references for each online method currently available within PlatformWeb. The examples, where possible, make use of the technology (eg. online discussion groups).

Some common themes provided by experienced practitioners in online teaching are the need for structure, relevance, support and the importance of the teacher-student relationship. At the 'classroom' level, the literature provides a wide diversity of strategies. Sometimes the advice can be contradictory. For example, some encourage the use of lurking in discussion groups [Freeman, 1997; Shneiderman et al., 1998] while others discourage it [Klemm, 1998]. Nevertheless, a range of strategies and examples are provided to allow staff to select what might work best in their own teaching context.

Research is currently underway to see the extent that online methods can compliment more traditional methods of staff development and to identify any trends in the characteristics of staff who prefer such methods.

References

Ellis, A., O'Reilly, M., & Debreceny, R. (1998). Staff Development Responses to the Demand for Online Learning and Teaching. *Proceedings of the 15th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)* (pp. 191-201). University of Wollongong: The Printery.

eman, M. (1997). Flexibility in access, interaction and assessment: the case for web-based teaching programs. *Australian Journal of Educational Technology*, 13(1), 23-39.

Hansen, S., Deshpande, Y., & Murugesan, S. (1999). Adoption of Web Delivery by Staff in Education Institutions. *AusWeb99 - Proceedings* .

Klemm, W. (1998). Eight Ways to Get Students More Engaged in Online Conference. *Technological Horizons in Education Journal*, 26(1).

Shneiderman, B., Borkowski, E., Alavi, M., & Norman, K. (1998) *Emergent Patterns of Teaching/Learning in Electronic Classrooms* [Web Page]. URL ftp://ftp.cs.umd.edu/pub/hcil/Reports-Abstracts-Bibliography/98-04HTML/98-04.html [1999, January 26].

Surry, D., & Farquhar, J. (1997). *Diffusion Theory and Instructional Technology. Journal of Instructional Science and Technology*, 2(1).

Wills, S., Nouwens, F., Dixon, S., & Lefoe, G. (1997). Teaching at a Distance about Teaching at a Distance: a Resource for Staff Development. *Proceedings of the 14th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)* Curtin University of Technology: Academic Computing Services.

Zuber-Skerritt, O. (1992). *Action Research in Higher Education: Examples and Reflections*. London: Kogan Page.

Enhancing Learning Outcome in Web-based Education through Understanding of Learner Profiles

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Abstract: This paper proposes a model relating student profiles and learning outcome in distance education courses offered on the Web. These profiles include: Age, GPA, ESL, learning strategy, attitude, motivation, and satisfaction. Data analysis so far has validated the influence of attitude and learning strategy variables on learning outcome. The conclusion is that students do best when their attitudes are matched to course format. Further, the Web is very conducive to students who use surface learning strategy that emphasizes memorization and reproducing ability.

Objective

Many Web-based courses subscribe to the paradigm that students learn equally if given the same materials. This ignores the fact that students bring with them a baggage of variables that influence their performance. During the evolution of instructional technologies in the last three decades, researchers have explored several issues regarding student learning performance in distance education. Earlier studies have compared performances between telecourses and lecture classes for groups of students but have largely bypassed the possible effects due to individual differences [Moore & Kearsley 96]. This research investigates what individual learner profile variables are likely to improve learning outcome in Web-based courses.

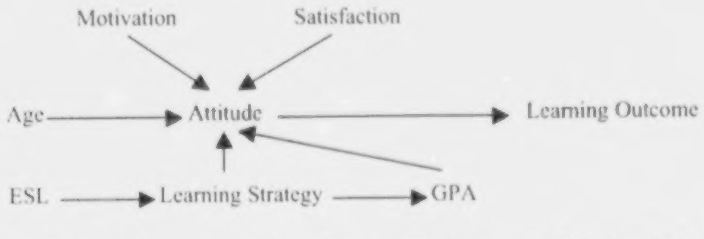

Figure 1: Proposed model showing variables influencing Performance in Web-based education

[Fig. 1] shows the complete proposed model that is currently being investigated. Preliminary results on effect of attitude and learning strategy as learner profiles on learning outcome are now available.

Methodology

The subjects of this study were students enrolled in an undergraduate business computer course (N=137). Fifty-six students chose the Web format and the remaining chose the lecture. The instructor covered the same course content in both formats. Students were given a pre-test to measure their knowledge of content. As a measure of performance, all students were given the same final test in a lecture hall. A survey measured the students' attitude to Web and learning strategies.

Results

Student Attitude and Learning

The Attitude to Web Score (AWS) was measured on a range of 1-5. The AWS for the Web group was 3.3, and for the lecture group was 2.7. The difference was significant (t=3.153; p=0.001). There was no difference between the Web and the lecture group in the final test scores (43.7 for the Web group vs. 44.3 for the lecture group (t= .732, p= .498). Additionally, when we computed the amount of learning achieved by subtracting the pre-test score from the final score, there was no significant difference between the groups either. The authors wanted to know how the performance was affected if there was a mismatch between attitude to web score and course format. Students with AWS of greater than 3.7 were considered Web-oriented, between 2.3 and 3.7 format-neutral, and those below 2.3 lecture-oriented. Their mean incremental test scores are in [Tab. 1]. Most gains were made when the attitudes towards Web and lecture were matched to the course formats.

	Web Oriented	Lecture Oriented	Format Neutral
Student	Incremental Scores		
Took Web course	15.4	8.2	11.4
Took Lecture course	9.3	18.8	12.3

Table 1: Relationship between Attitude and Incremental Test Score

Student Learning Strategies and Performance

We studied the two types of learning strategies proposed in literature [Hoeksema 95] - deep (thorough understanding) and surface (memorizing). Our analysis showed that students who used either deep or surface learning strategies performed equally well (t=.294, p=.755). The reason can be that in practice, deep learning is often not required to satisfy many university examinations [Vermunt 96]. In this study, students who used deep learning strategy performed slightly better in the lecture group, whereas those who used surface strategy did slightly better in Web group. The explanation could be that the Web, with no direct verbal interaction, lends itself better to the presentation of course material in a structured manner. Important points in the material can easily be picked from the concise and organized web materials than in the detailed explanations of a lecture.

Implications

Students do show their preferences to formats in which they wish to take their course and perform better when they match the format. Thus, it would be beneficial to offer a course in multiple formats if at all possible. Our study also showed that students who use either deep or surface learning strategy perform well in both Web and lecture courses. Since the course content in both formats in our study was the same, it appears instructors who are planning to offer their lecture courses in Web format may be able to adapt their material with minimum redesign. This is encouraging to instructors who are contemplating the use of Web-based courses for the first time.

References

Hoeksema, L. H. (1995). *Learning strategy as a guide to career success in organizations*. Leiden University, The Netherlands, DSWO Press.

Moore, M. G. & Kearsley, G. (1996). *Distance education: A systems view*. NY: Wadsworth.

Vermunt, J. D. (1996). Metacognitive, cognitive and affective aspects of learning styles and strategies: a phenomenographic analysis. *Higher Education*, 31, 25-50.

Grammar Based Navigation Flow Control
For E-Commerce Applications

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Abstract: A novel approach to web site navigation design is proposed in this paper. The design of a web site is viewed as a task decomposition that can be represented in the form of a context free grammar (CFG). The terminals of such grammars are URIs. The CFGs are written to clearly capture the task-structure of the web site. An algorithm is presented which will convert such grammars to a linked web site. The URIs are linked to each other using the FIRST/FOLLOW set information in order to produce the web site navigation design. An example application demonstrates the utility of the proposed CFG approach to web site navigation design.

1 Introduction

One of the important aspects of E-commerce application web page is the definition of transitions between pages within a domain. The design of the link structure in hypertext domains is crucial for building flexible and efficient navigation systems. The common approaches to design of navigation link structures are:
a) Graphical Approach: Heuristics that designers use based on web site development experience. This is usually done with the help of graphical web site development tools.
b) Database approach: The problem of navigation is viewed as a database access problem, and various database techniques applied towards the navigation link design. For instance, [Shwabe & Rossi 98] defines navigation class schema that's manually constructed, and various example scenarios used to actually develop navigation structures.

2 Web Sites and CFGs

It is important to structure these link transitions, rather than solely rely on the web page designers structural view, or depend on example scenarios that are difficult to generate/obtain. As an alternative, we present the "Context Free Grammar Based Flow Control Determination". The idea is to layout the web site structure in the form of a grammar. The algorithm for designing web sites using CFGs is as follows:

Algorithm **CFGLinkage**

Step 1: Write the web site as a CFG
Step 2: Identify Non-terminals that derive in a single step to terminals (URIs)
Step 3: Compute the FIRST and FOLLOW sets of all non-terminals
Step 4: Reduce the sets determined in step 3 using only non-terminals identified in step 2
Step 5: Extract the linkage structure using the output of step 4

3 Example Design

For example, a generic E-commerce application can be specified as follows: (Remaining non-terminals 1-step derive URIs).

```
<ECOMM_APP> --> <INTRODUCTION> <NEW_PURCHASE> <GOODBYE>
<INTRODUCTION> -->  <HELLO_KNOWN_USER> | <HELLO_NEW_USER>
```

<NEW_PURCHASE> --> <SELECT_ITEM> <BUY_TRANSACTION>
<BUY_TRANSACTION> --><GET_CUSTOMER_INFO><VERIFY_PURCHASE_LIST><COMPLETE_PURCHASE>
<COMPLETE_PURCHASE> --> <AUTHORIZE_PAYMENT><DO TRANSACTION>

Individual web pages are classified into modules such as *<INTRODUCTION>* pages, *<GET_CUSTOMER_INFO>* pages and so on. These smaller modules can themselves be represented in terms of a context free grammar as non-terminals (hyperlinks). Next, we apply techniques from Grammar and compiler theory [Aho et al 99] in order exploit such CFG (Context free grammar) structures. Each term in the grammar within angled brackets (<..>) can be regarded as a non-terminal. The FOLLOW(<N>) can be computed using the algorithms specified in [Aho et al 99] (to build parsers). <N> is a non-terminal in the grammar. The FOLLOW set corresponds to all the nonterminals that can follow the nonterminal <N> as specified by the grammar. Now, certain documents belonging to the nonterminal set can be classified as "ENTRY" and "EXIT" pages. Each page P in the set <X> will have links to the FOLLOW(<X>)). Thus, the structure embedded in the context free grammar is incorporated in the web document link structure.

We have implemented a Java program that takes in a CFG as input and produces the set of follower links for each non-terminal. Thus, given a web site grammar, the Java program automatically generates the web site link structure. The proposed approach also allows the concept of "virtual hypertext documents". These correspond to non-terminals that are purely used in the structuring of the web site and do not have any URI addresses associated directly with them. The FOLLOW set of the example grammar shown above is computed, and the FOLLOW sets of all non-terminals that have a one step derivation to terminals are used to make the web site traversal graph. Using the above method, the web site navigation can be constructed as shown in **[Fig 1]**.

FOLLOW(<HELLO_KNOWN_USER>) = { <SELECT_ITEM> }
FOLLOW(<HELLO_NEW_USER>) = { <SELECT_ITEM> }
FOLLOW(<SELECT_ITEM>) = { <GET_CUSTOMER_INFORMATION> }
FOLLOW(<GET_CUSTOMER_INFORMATION>) = { <VERIFY_PURCHASE_LIST> }
FOLLOW(<VERIFY_PURCHASE_LIST>) = { <AUTHORIZE_PAYMENT> }
FOLLOW(<AUTHORIZE_PAYMENT>) = { <DO_TRANSACTION> }
FOLLOW (<DO_TRANSACTION>) = { <GOODBYE> }

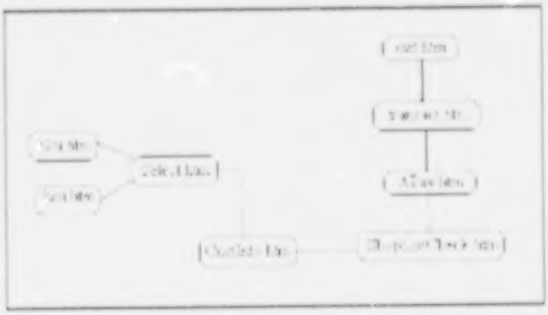

Figure 1: Generated Web Site Linkage From CFG Description

4 References

[Schwabe & Rossi 98] D. Schwabe, and G. Rossi (1998), *"Developing Hypermedia Applications using OOHDM"*, Workshop on Hypermedia Development Process Methods and Models, Hypertext'98, Pittsburgh, USA.

[Aho et al 99] Aho, Sethi & Ulman(1999), *"Compilers: Principles, Techniques and Tools"*, Addison-Wesley.

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iNK (interactive News for Kids) – a web-based collaboration and learning environment for children.

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This paper introduces a system developed in 1997/98/99 by the Institute for Interactive Multimedia (IIM) at the University of Technology, Sydney (UTS) in collaboration with the Australian News Limited group. iNK (Interactive News for Kids) is an integrated web-based resource center and collaborative authoring, workflow and publishing environment for primary and secondary students that is specifically designed to allow students to concentrate on producing an online newspaper and not on the underlying technology. In this paper the author will introduce the features of the system and discuss some of the underpinning pedagogy that informed the conceptual, prototyping and design phases.

The iNK system is designed to 'help students learn the skills involved in how a newspaper works', including:

- news reporting
- feature writing
- opinion writing
- picture stories
- headline writing
- caption writing
- using cartoons for political or social comment
- producing a newslist (understanding newsworthiness)
- publishing an on-line school newspaper

It was initially thought that the site could be a resource of static HTML materials related to the processes of journalism and news production and it was suggested that production of the online newspaper could be facilitated by manually marking up stories submitted by email. However on closer inspection this seemed both labour intensive and potentially unscalable.

Drawing on the author's experience with TopClass (a Web-based Learning tool) at UTS it was proposed that the learning experience should be engaging and qualitatively different from anything achievable face to face [Sawers and Alexander 1998]. After significant research into other available online resources it became evident that for the site to be successful it would need to be interactive, dynamic and collaborative and provide something more than the equivalent of lecture notes and support materials online [Alexander et al., 1998].

The site was designed to help students learn the journalistic processes by actively participating in the production of an online newspaper, by providing them with a team based role-play simulation of the processes that occur in a 'real' newsroom.

A group of students and teachers register to produce an online newspaper for their school which eventually becomes a live edition in the iNK system. They are each assigned a role which has a particular behaviour and capabilities. By logging into the iNK newsroom (via a standard web browser) with a username and password they assume that role and are given a virtual workspace and a set of tasks to complete. The roles of cartoonist, photographer, reporter, sub-editor, chief of staff, editor and publisher are defined in the system and inter-relate in the following ways:

- the **editor** registers their students online to produce an iNK edition http://ink.news.com.au/ink/register
- the **publisher** contacts the **editor** by phone and then creates the edition.
- an email message is sent to the **editor** with details of usernames and login passwords.

- the **editor** logs-in to the iNK newsroom and invites the **news team** to participate in a news conference using the in-built messaging system.
- the **news team** send ideas for stories to the **editor.**
- the **editor** creates story briefs in the **newlist.**
- the **chief-of-staff** assigns the story briefs to **reporters** and associated image briefs to the **photographers** or **cartoonists**.
- the **reporters** receive their briefs, research and write their stories and then submit these to their **sub-editor** for approval.
- the **photographers** receive their briefs, produce images for the stories and submit these to the **sub-editor**.
- the **cartoonists** receive their briefs, produce images for the stories and submit these to the **sub-editor**.
- the **sub-editor** checks the work and if it requires changes to be made it is passed back (with comments) to the **reporters** or **photographers** or **cartoonists** who make the suggested changes and resubmit. This review-change cycle repeats until the **sub-editor** feels that the work is of sufficient quality to submit to the **editor**.
- the **editor** (a Teacher) checks the work and accepts it or if necessary passes it back to the **sub-editor** and so on down the line until there is sufficient work of sufficient quality to make up the full publication.
- the **editor** then submits the publication content to the **publisher.**
- the **publisher** checks the work and if it is appropriate and has been submitted within the assigned timeframe it becomes one of ten current on-line editions on the iNK server.

The iNK system was officially launched on the 19th of march in Sydney Australia and currently has 700 students and teachers producing work in the virtual newsroom. iNK can be found online at http://ink.news.com.au.

Acknowlegements

No system of this scope and complexity is the work of a single individual but the product of a team effort. The author would like to acknowledge the significant input of the following individuals; Professor Shirley Alexander (educational design), Maralyn Parker (news and journalism process research), Cindi Drennan (visual design), Kate Sumner (writing), Lissanne Oliver (iNK name), Andrew Francois and Danielle Hickie (visual design), Justin Mclean (Cold Fusion and SQL programming), Justin Maynard (proof of concept programming) and all the team at the IIM.

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References

Alexander, S., McKenzie, J. and Geisinger, H. (1998) *An Evaluation of Information Technology Projects for University Learning*. Committee for University Teaching and Staff Development. Canberra, Australia.

Sawers, J and Alexander, S. (1998) A Centralised approach to the adoption of a University wide Web-based Learning tool, *Proceedings of ASCILITE '98*.

A Design Tool For Classifying The Level Of Interactivity And Amount Of Instruction Delivered Online

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Abstract: This paper explores a classification system for the level of interactivity and the amount of instruction delivered online. First, we introduce the underlying need for better initial design of online courses. A brief review of other classification systems and models is presented. Then a rationale for this classification system is presented, explaining the choice of the two measures of level of interactivity and amount of instruction delivered online, as well as defining both measures. Ways to use the classification system in designing online courses are proposed.

An Introduction to Online Course Design Need

Within the higher education community, there is a great debate about how to best provide online instruction, or even whether online instruction provides equivalent learning to traditionally delivered courses (Russell, 1998). However, for many, including recent graduates of the first degree-granting, Internet-only university to receive accreditation (Jones International University), that debate-is moot [Bulkeley, 1999]. With this increasingly popular perception that online education is inevitable, many universities, colleges, corporations, and other providers of instruction and training are rushing to convert existing courses to an online environment. As of June, 1999, TeleCampus, an education clearinghouse reports over 12,000 classes offered by 700 colleges and other teaching organizations located throughout the world [Thornton, 1999]. Confronted by this reality of tremendous growth in the demand for online courses, higher education administrators are facing a daunting task in developing a usable taxonomy to guide them through this morass. To aid in this attempt, we propose a process for identifying common characteristics of existing courses as well as characteristics of online courses. The proposed process is implemented graphically with an interactivity/online matrix, facilitating rapid examination of existing courses within a context of degree of interactivity employed in the course as well as the context of amount of instruction delivered online. To better understand the proposed matrix, a brief review of other classification systems and models is presented.

A Brief Review of other Classification Models and Systems

The ACTIONS (Access Costs Teaching Interaction Organization Novelty Speed) Model [Bourdeau and Bates, 1996] provides a connection between the instructional design and distance learning world. Analysis of each of the ACTIONS criteria aids in selection and use of technology for Distance Learning and focuses primarily on cost/media usage tradeoffs. Another model focuses on building interactivity into web courses using two categories of interactivity, social and instructional [Gilbert and Moore, 1998]. This model characterizes the level of teacher, learner, and group influences in computer-mediated learning along a continuum of instruction types which range from directive, content interactive, directed collaboration, collaborative to social. Another model called Asynchronous Learning Networks (ALNs) using Computer-Mediated Communication (CMC) [Hiltz, 1997] illustrated the proposition that online learning is more effective utilizing a collaborative learning design such as the ALN than a pedagogical approach with an individual working alone and posting the results online.

These models provide insight into the necessity to clearly understand why interactivity is being used or considered for use in an online environment. The matrix aids in clarifying where current or prospective courses fall in their use of interactivity and amount of instruction delivered online.

Matrix Characteristics and Rationale

The proposed matrix can provide an initial framework for comparison and discussion with administrators and with faculty and instructional developers. The form that results from examining the two characteristics of interactivity and online delivery yields a matrix with two axes that can be graphically presented. The matrix is designed to be used as a tool that facilitates the classification of current teaching methods as well as providing options for alternative ways of designing a course. To see the matrix, access the Internet and go to this URL:
http://dle.byu.edu/research/matrix/

The horizontal axis of the matrix is characterized as representing the amount of instruction delivered online. It ranges from the left hand entry that represents courses with no current online content to the right hand entry representing courses that have high online content. The vertical axis of the matrix represents the amount of interaction occurring within the course. The bottom left of matrix portrays courses that have no teacher/student or student/student interaction (from a point of view that states that lectures, delivered without a question/answer mechanism present no teacher/student interaction). Additionally, the course always meets face-to-face with the instructor delivering instruction in an uninterrupted lecture format. As one moves up the matrix vertically, the amount of interaction of both teacher/student and student/student increases until the top of the matrix is reached. At this row of the matrix, participation in group activities is required and high teacher/student and student/student interaction is typical. As one moves across the matrix horizontally, the amount of instruction delivered online increases until the entire course is delivered online, including course reading materials.

The matrix can be used to clarify to faculty and instructional designers where their existing courses fall in an online orientation. Another usage of the matrix could be to facilitate moving existing courses from one part of the matrix to another. It is appropriate here to indicate that no value per se ought to be placed on location of courses on the matrix. In fact, we urge that administrators not make value judgments about a course based on location on the matrix. Some courses such as business management case studies lend themselves to high interactivity while others such as physical fitness courses emphasizing individual fitness do not. A course located at the top, right of the matrix (high interactivity and high degree of online content) is no better designed than a course located elsewhere and may be less well designed if the interactivity inserted into the course is artificial and detracts from student learning.

Instructional designers can make effective use of the matrix as they work with content experts in developing courses. The matrix offers visual prompts for discussing appropriate uses of technology in new or existing courses. Online technologies currently available contribute to instructional designers' abilities to add more meaningful interaction to courses through synchronous chat sessions and dedicated group discussion areas. As designers and content experts discuss how the course is currently taught or envisioned to be taught, the matrix provides guidance in clarifying understanding of why a course is placed as it is on the matrix—some courses are best taught via more traditional methods with a high degree of face to face interaction. Similarly, course content also can determine the amount of instruction that can effectively and efficiently be delivered online. For example, a current course which relies heavily on printed material may continue to employ printed material rather than place that material online when the course is converted to an online alternative.

Ways to Use the Classification System when Designing Online Courses

The matrix is a web-based, interactivity tool that can be used by educators to explore different design options for combining interactivity and the amount of instruction to be delivered online. This classification system is currently being used at the university level to assist instructional designers collaborating with faculty in designing online courses. The sample scenarios provided in the matrix help faculty realize that there are a variety of approaches to using online learning in the classroom and at a distance.

Future Research

Future versions of the matrix may consider course characteristics such as types of multimedia supported via the instructional environment, degree of mediation, types of learning styles supported, number of learning modalities supported, and degree of synchronous scheduling required. Other aspects of research to consider?

Note: this presentation and the matrix it highlights represent the current iteration of an ongoing research project. Some courses have been identified as examples for particular cells in the matrix. While every effort has been made to correctly classify each course example, given the information that was available, this matrix does not constitute a comprehensive analysis of all the courses offered by any of the institutions listed. (This would reveal who we are).

References

Russell T.L. 1998. *The no significant difference phenomenon.* Raleigh, NC: North Carolina State University Press.

Bourdeau, J. & Bates, A. (1996). Instructional design for distance learning. *Journal of Science Education and Technology*, 5 (4) 267-283.

Bulkeley, 1999. The Wall Street Journal Interactive Edition, http://public.wsj.com/careers/resources/documents/19990317-bulkeley.htm

Gilbert, L., & Moore, D.R. (1998). Building interactivity into web courses: tools for social and instructional interaction. *Educational Technology*, May-June 1998.

Hiltz, S. R. (1997). Keynote address for UNESCO/Open University Symposium on Virtual Learning Environments, given April 28, 1997 at Milton Keynes, England. (Published by NJIT, 1997).

Holmberg, B. (1986). *Growth and Structure of Distance Education.* Croom Helm. London, England.

Thornton, 1999, CNN Interactive, http://cnn.com/TECH/computing/9906/07/school.idg/

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Collaborating Across Disciplines and Departments to Create a Virtual Foreign-Language Library: A Work in Progress

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Abstract: A multicultural, cross-disciplinary team has initiated a three-phase project to create a virtual foreign-language library focusing on Spanish. In this paper, phase one—determining heuristics and analyzing a sampling of existing FL-web-sites and virtual FL-libraries—is discussed.

At Michigan Technological University (MTU), a team comprised of one foreign-language (FL) educator and two librarians, one of them specializing in web design and the other in visual representation, have come together to create a pilot virtual FL library. This library will be designed to support technology-intensive FL classes, to enhance student engagement in FL courses and in intercultural communication, and to integrate information literacy skills into the FL classroom. The pilot project focuses on resources in Spanish language and culture, and consists of three phases: 1) determining heuristics and analyzing a sampling of existing FL web-sites and virtual FL libraries; 2) determining and organizing the content to be included in a pilot virtual FL library; and 3) creating a model multimedia web site for delivering this library. Phase one is the focus of this paper. Major goals for this phase were the establishment of heuristics that would guide both the initial analysis and the development of our virtual FL library, and the comparative analysis of virtual FL resources.

The creation of a specialized virtual library requires diverse kinds of traditional and evolutionary expertise, as well as new patterns of cross-disciplinary and organizational collaboration, especially among faculty and librarians (Hansen, 1997). It also raises fundamental questions regarding the distinctions between virtual and conventional libraries in regard to mission, defined audience/community, scope, content selection and creation, organization, access, maintenance, archival/preservation functions, continuity, and application of standards (Waters, 1998).

Team collaborators began phase one by conducting an extensive search for Internet FL resources focused on Spanish language and culture. Search results included organizational, educational, personal, and commercial sites created by private individuals including learners and native speakers of Spanish, K-12 teachers, university professors, and librarians.

After reviewing existing heuristics for web-evaluation and design (e.g. de Jong & van der Geest, 1999; Kristof & Satran, 1995) and web style guides for general and instructional web sites (e.g. Lynch, 1999) team members adapted these heuristics to accommodate the specific nature of FL sites and FL pedagogy and created a linear arrangement of heuristic elements—design, rhetoric, pedagogy, content, technology and representation. They then applied the heuristics to a few test sites. The test application revealed that the linear statement of heuristic elements failed to acknowledge the synergistic relationships existing among these elements both in theory and in their functioning within sites. For example, one site evidenced the rhetorical strategy of inserting the logo of an organization supportive of illegal immigrants' rights into a resource page. To emphasize these synergies, we designed a dynamic heuristic model in the shape of a hexagon.

The goal of our site analysis was to identify general trends and patterns. Our analysis of sites created by professional librarians, many of whom were subject specialists or coordinators, indicated that these sites were not titled virtual libraries per se. Instead, they were referred to as guides, collections, pathfinders, and resources, e.g., *Subject Guide to Internet Resources*, *Guide to Spanish Language Sources on the Internet*, *Latin American Collections*, *Internet Resources for Latin American Studies*, and *Pathfinders to Spanish Resources*. Unlike many other sites, FL virtual libraries displayed their mission statements prominently. In addition, their organizational structures were readily transparent to users and they provided evaluative annotations to guide users' selection of resources. They often provided access to licensed electronic resources and links to local departmental pages. Print resources housed in physical collections were made available through such means as subject pathfinders and the inclusion of call numbers. Some of the sites maintained mirror sites in Spanish and English. Overall these sites added value to their physical and virtual collections by tailoring their web sites to the information needs and use patterns of their campus and larger community.

Given the above, these web sites conform to many of the common definitions for digital and/or virtual libraries: 1) "libraries that offer access to digital information using a variety of networks including the Internet and World Wide Web" (Saunders, 1999); 2) "information housed electronically and deliverable without regard to its location or time" (Saunders); 3) a collection of, or an organization underlying the collection and provision of, digital works so that they are readily and economically available for use by a defined community (Waters, 1998).

Analyzed sites that did not conform to these definitions could be placed in broad categories such as teacher-created resources, layperson guides, and commercial language tutorials. These sites displayed a much wider variety of structure, organization, content, scope, level of abstraction, sophistication, and design. Among the most striking characteristics of the analyzed FI web-sites were their hybridity and their fusion of educational, commercial, and personal, even ideological elements. This hybridity reflects the very nature of the Internet, hypertext, and digital technologies and led us to review our understanding of the virtual library, in particular the challenge of balancing collection/resource integrity—as practiced in the conventional library—with a philosophy of content inclusiveness. Resolving this tension, which is founded on the making of value judgements and the creation of standards, will be critical to the creation of our own virtual library.

Major issues for phase two of our project will include determining guidelines for providing access to and/or integrating collections of digital materials with materials in other forms (Waters), defining the areas of responsibility, decision-making, and authority for the librarian, educator and designer; formulating criteria for site inclusion; and determining which hypermedia technologies to employ in support of specific dimensions of FI learning and pedagogy.

References

de Jong, M., & van der Geest, T. (1999). *Framework for Characterizing Heuristics in Web Site Design* [Online]. Available: http://www.uwtc.washington.edu/international/workshop/1999/ [1999, September 5].

Hansen, C., & Lombardo, N. (1997). "Toward the Virtual University." *Research Strategies*, 15 (4), 68-79.

Kristof, R., & Satran A. (1995). *Interactivity by Design: Creating & Communicating with New Media.* Mountain View: Adobe.

Lynch, P. J. (1999). *Web Style Guide: Basic Design Principles for Creating Web Sites.* New Haven: Yale.

Saunders, L. M. (1999). . "The Human Element in the Virtual Library." *Library Trends* [online] 47/4, 12 pp. Available: InfoTrac/Expanded Academic Index, A55248855. [1999, August 27]

Waters, Donald J. (1998). "What Are Digital Libraries? *CLIR issues.* [Online]. Available: http://www. Clir.org/pubs/issues/issues04.html [1999. July/August].

Streaming Technologies in Tele-Learning

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Abstract: Initial results of a study on the potential application of streaming and related technologies in tele-learning are reported in the following. The emphasis is on the streaming of interactive three-dimensional moving images.

Introduction

Of all the technologies that exploit the potential of the Internet and the World Wide Web, one of the most intriguing and, at the same time, the most challenging from the point of view of implementation, are those that are summarized under the heading of "streaming." The intuitive idea is easily enough grasped: continuous information is to sent from a source to a subscriber through the Internet in much the same way that a television broadcast signal is sent through the television broadcasting system, either via spatial channels or cable television channels, in an unbroken, smooth, continuous way. The signal is thus "streamed" and, if everything works well, one can receive on one's workstation a television program, an FM music broadcast, and other such continuously streamed information.

This method of transmitting information is to be contrasted with the method whereby a file of continuous information, video or sound, is first downloaded then played. In the case of streaming the action is virtually real-time: the source broadcasts and the receiver displays the contents as it comes in, whereas in the conventional download case, the spurce transmits a file which is stored locally, then may be displayed ("played") later.

Three-Dimensional Graphics and Streaming

Streaming becomes all the more interesting when one attempts to transmit three-dimensional images, specially as in, say, such as Nintendo's "Zelda." In such games, one may maneuver oneself around in three-dimensional space: it is as if the user her/himself were embedded in the space being displayed. This type of streaming places special constraints on the streaming technology being used: it must permit upstream signals in real-time that will change the sequences of images being transmitted downstream to the images corresponding to the change in spatial orientation.

The applications of streaming in general boggle the mind: video-on-demand, news services, games, stereo music, and many others suggest themselves. In this work, we wish to explore the potential uses of streaming in tele-learning. This work is part of more general work on tele-learning that is being carried out at Asahi University [Finley et al 1999] and represents work in progress.

In this work, we are examining the whole gamut of streaming technologies, Both those that will accommodate three-dimensional streaming as described above as well as the more standard non-interactive types. We are testing both plug-in versus Java-based forms of streaming.

Streaming with interactive three-dimensional graphics is very promising in tele-learning, since the student will be able to navigate a "course" or "learning" space. That, just as in an interactive three-dimensional game such as "Zelda," the student will be able to follow various "paths" through the space in which the objects to be studied may be presented in three-dimensional form.

Work in Progress

At this point, the emphasis is on the implementation of such as system and not on the courseware per se, although clearly the latter is of a non-trivial nature and must necessarily be dealt with at a later time. The implementation problems include such matters as Internet delays, workstation power, coding and compression techniques and so on.

In this part of the study, we are making a detailed inventory of the tools existing today that will permit us implement three-dimensional streaming as described above and are testing various products that are promising for the intended applications. In the full paper, we shall give an overview of these technologies and of the trials we are currently designing for this form of streaming. At the conference, we hope to be able to give a demonstration of the system developed so far.

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References

Finley, M.R., Akimaru, H. and K. Yamori, "Tele-Learning Trials at Asahi University," Proceedings 7-th International Conf. On Telecommunications Systems, March 18-21, 1999, Nashville, Tennessee, pp 524-530.

Computer-Aided Learner Electronic Portfolio Software Development

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Abstract

The purpose of this paper is to briefly describe our research with respect to the development of several recording and portfolio tools. These tool can record events after they have occurred, present extant text material in hypermedia format, and create portfolios for students and teachers that automatically incorporate video evidence of accomplishment.

Past Recording Software

PastRecorder transfers audio events to a random access memory buffer that is constantly being rewritten (Speitel et al. 1997). The user selects a duration for the buffer (e.g., 10 seconds). When the user presses the "record" button the "past" is locked in RAM while the "present" is recorded to hard drive. When the user indicates that the recording should stop, the "present" audio is preserved on the hard drive, with the buffered past (in this example, 10 seconds) inserted at the front of the audio file. The user is provided with the advantage of being able to decide to record something *after* they have heard it, rather than unselectively recording an entire event, such as a meeting or lecture. Hence, the software's name, PastRecorder.

One of the aspects of machine interviewing that we are examining is further uses or applications for pastrecording. In previous research (Speitel et al. 1997), we described uses that included students in lectures, people in meetings, persons with learning disabilities, visual or motor impairments that might affect rapid note-taking capabilities in lecture settings. We are in the process of investigating persons with slight hearing impairments who might miss a few things that would be helpful to record.

Professional uses that we are investigating include:

- linguists who are targeting certain types of utterances for further study. The targeted utterances could be recorded via PastRecorder as an adjunct to a full tape recording of the entire conversation, so that the whole context can be preserved, yet specific utterances can be examined in rapidly.
- ethnographers who might be interested in looking for specific kinds of verbal interactions for study.
- foreign language and ESL teachers who wish to preserve certain utterances for further study or as feedback to students.
- speech pathologists and related professionals who wish to collect data from clients repeatedly as indices of progress and as feedback to clients who need to replicate specific kinds of utterances.

In this presentation we will briefly share the status of our work with PastRecorder and its uses and provide a brief demonstration.

Computer-Aided Electronic Science Book/Instructional Guide

The second prototype tool is a computer-based multimedia science text, based on the Hawaii Marine Science Studies (HMSS) marine science texts, *The Living Ocean: Biological Science and Technology of the Marine Environment* and the *Fluid Earth.: Physical Science and Technology of the Marine Environment*. The multimedia instructional guides incorporate the original texts, along with several forms of assistance or enhancement for students, including video, sound, text, and pictures (Speitel et al. 1999). Additional types of assistance include definitions, examples, hints, rewordings of text, pronunciations, pop quizzes, and cross-referencing between figures and text.

One of the foci of our development of the electronic science text is the development of materials that most effectively facilitate comprehension, especially among low-level reading or low-level science students that might lack metacognitive skills and be less likely to effectively monitor their own understanding. This process becomes even more central in working with multimedia presentations that afford numerous decisions on the part of readers about what they will examine further, etc. (Iding In Press). To facilitate metacognitive skills, especially effective comprehension monitoring skills, we are working with several major goals or questions that accompany our development of the science text. How can strategies be taught embedded within the book to facilitate effective comprehension monitoring and decision-making processes? What are optimal forms of note taking that can be built into the book so students may create "records" of their interactions in this type of environment?

Computer-Aided Electronic Portfolio Prototype Tools

Student electronic portfolios provide tools in which students can record and assess what they know or are capable of doing in ways that are useful for instructors and/or peers and others to view and respond to. Electronic portfolios can incorporate video, audio, and textual data. Questions that guide our current development of these prototypes include: What are factors that contribute to likelihood of teachers' use of these tools? Which aspects of electronic portfolios can most effectively be incorporated on-line with the electronic science book so teachers and students can incorporate the ongoing scientific investigation and inquiry so essential to the constructivist framework in which the science text was originally designed?

Electronic portfolio tools would be especially effective in conjunction with science texts because students can explain their own understandings of scientific phenomena. Students' levels of understanding of scientific phenomena as revealed via their own explanations would be of particular interest to teachers as students' potential misconceptions or preconceptions or incomplete understandings can be readily detected and challenged, if necessary. Additionally, students can challenge their own and each other's levels of understanding in a collegial and collaborative fashion, and, in viewing individual portfolios, see the development of appropriate levels of understanding or more complete understandings over time. This use of electronic portfolio tools as a performance assessment for students' and teachers' ongoing hypothesis building also provides a framework for epistemological development in science, and for attitudinal change.

Conclusion

In addition to facilitating science learning, several of these tools (e.g., PastRecorder and electronic portfolios) and related research among all of these technologies can be used to enhance learning in other content areas. Finally, as a conclusion to our presentation, work with teachers and their suggestions for optimal incorporation of such instructional tools into classes and existing curricula will be discussed.

References

Iding, M. (In Press.) Is seeing believing? Features of effective multimedia for learning science. *International Journal of Instructional Media*, 28(1).

Speitel, T. & Iding, M. (1997). Audio past recording software for computer-assisted learning. *Computer Assisted language learning*, 10(4), 339-347.

Speitel, T., Iding, M., & Klemm, E.B. (1999). Hypermedia enhancement of print-based constructivist textbook. In H. J. Bullinger & J. Ziegler Eds.), Human-Computer Interaction: Ergonomics and Human Interfaces, Volume 1 of the *Proceedings of the 8th international conference on Human-Computer interaction*, 372-375. London: Erlbaum.

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Researching and Developing Multimedia Learning Environments: A Web-delivered Virtual Classroom for Teacher Education

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In this paper, we present an innovative, web-delivered learning environment for teacher education, the Generative Virtual Classroom. This virtual classroom was designed to address a set of longstanding and seemingly intractable problems concerning the failure of teacher education to stem the tide of students' alienation from the study of technology and science (Seymour, 1995; Tobias, 1999). Typically, in Australia, as elsewhere, elementary school teachers lack confidence in technology and science and in their ability to teach these, often devoting little classroom time or effort to them (for example, Harlen, 1997). Furthermore, in the absence of accessible models of exemplary technology and science teaching, these teachers' views of learning (simply as instruction) appear to obstruct effective, investigative technology and science learning (Schmidt, McKnight and Raizen, 1997); and research-based attempts at innovation fail to permeate classrooms (White and Klapper, 1994). So as to address these problems, the Generative Virtual Classroom was envisaged as an information-age solution to the challenges of delivering the required, sophisticated professional development to large numbers of teacher education students, typically widely dispersed in time and space.

The prototype version of the Generative Virtual Classroom emerged from a sustained research and development program investigating early technology and science learning. Early studies (in the Learning in Science Project at Hamilton Teachers' College and Waikato University's Learning in Science Program and the Learning Research and Development Group at the University of Technology, Sydney) revealed the technological, scientific and philosophical ingenuity of young children (for example, Cosgrove, 1995; Cosgrove and Schaverien, 1994, 1996); and attention then turned to how to enhance often reluctant elementary school teachers in nurturing these children's ingenuity in their classrooms (Schaverien and Cosgrove, 1995, 1997a). A year-long, classroom-based mentor-supported approach was demonstrated to be of particular benefit in achieving the kinds of profound development in teachers' views of learning required to teach technology and science effectively. However, a way of scaling up these single-case interventions was needed for significant penetration of such sophisticated teaching approaches into classrooms. The Generative Virtual Classroom responded to this challenge.

As a product of a research program which conceived of learning as a generative act (after Wittrock, 1974, 1994; Minsky, 1985), the Generative Virtual Classroom was designed not only to develop Education students' understanding of this view of learning, but to do so in ways which are themselves in tune with such a view. In essence, therefore, the view of learning at the core of the Generative Virtual Classroom's design and operation is one in which learning is seen to be an adaptive behaviour of learners: that is, as iterative cycles of generating and testing ideas, on their value, keeping those which survive these tests (Plotkin, 1994, 1997; Edelman, 1992, 1993; Schaverien and Cosgrove, 1997b, in press a, in press b). Such a view is powerful in making sense of the learning at two nested levels of the Generative Virtual Classroom: as a behaviour of the children in the virtual elementary classroom, whose learning is at the core of the Classroom; and as a behaviour of the tertiary students in the virtual University classroom, who reflect on the children's learning, and their own, as they work in an electronically mediated learning community.

In the Generative Virtual Classroom, learners are able to view and review exemplary technology and science learning and teaching events, which they can select from a library of Quicktime movies. They can make personal notes about these events in a notepad for their private use and they can record ideas about particular, salient features of these events, in a searchable database. This database can also be used by learners to track the development of their ideas over time and to access other people's ideas about learning events. Learners can also participate in discussion of events with other members of the learning community by way of a threaded email discussion group; and they can access pre-recorded commentary about these events from the perspective of a particular (generative) view of learning. Learners are encouraged to treat this view as a plausible alternative way of making sense of the learning they observe and to think about whether they agree with it or not and why. The present version of the Generative Virtual Classroom (Version 3) is a hybrid system which uses a web browser to integrate the delivery of video from CD-ROM and data access via Cold Fusion (http://www.allaire.com/) from a back-end database over the Internet. The interface is created by the use of HTML frames.

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So far, research has proceeded in parallel with development of the Generative Virtual Classroom. Two sustained, single-case autobiographical studies of learning in the Classroom have been undertaken (Allard, 1998; Sen, 1999). One (Sen, 1999) describes the learning of a postgraduate research student who became a member of the project team which developed the prototype version of the Classroom. The other (Allard, 1998) describes a nine-month study in which an Honours Bachelor of Education student investigated her own learning. Both studies affirm the worth of this computer-mediated learning environment in deepening students' views of learning, assisting them to be able to articulate their views of learning with confidence, to recognise learning when it occurred and to describe what they did not yet know but wanted to know about learning. Now that the Generative Virtual Classroom is robust and fully browser-based, we are poised to undertake a full-scale research investigation of learning in the Classroom with a large cohort of undergraduate Education students.

In this paper, the current version of the Generative Virtual Classroom will be demonstrated, its solution of design problems of the prototype version explained and opportunity for critical discussion of such research-based learning environments provided.

References

Allard, M. (1998). What is learning in itself? One teacher education student's autobiographical account of her developing views of learning in the Generative Virtual Classroom. Unpublished Bachelor of Education (Honours) thesis, University of Technology, Sydney, Sydney.

Cosgrove, M. (1995). A study of science-in-the-making as students generate an analogy for electricity. *International Journal of Science Education 17*(3):295-310.

Cosgrove, M. and Schaverien, L. (1996). Children's conversations and learning science and technology. *International Journal of Science Education 18* (1): 105-116.

Cosgrove, M. and Schaverien, L. (1994). Technology learning 1: Towards a curriculum for children who are technologists. *International Journal of Technology and Design Education 4*:227-240.

Edelman, G. (1992). *Bright Air, Brilliant Fire: On the matter of the mind.* London: Basic Books.

Edelman, G. (1993). Neural Darwinism: Selection and reentrant signaling in higher brain function. *Neuron 10*: 115-125.

Harlen, W. (1997). Primary teachers' understanding in science and its impact in the classroom. *Research in Science Education 27*(3), 323-337.

Minsky, M. (1985). *The Society of Mind.* New York: Touchstone.

Plotkin, H. (1997). *Evolution in Mind: An introduction to evolutionary psychology.* London: Penguin Books.

Plotkin, H. (1994). *The Nature of Knowledge.* London; Allan Lane, the Penguin Press.

Schaverien, L. and Cosgrove, M. (in press a). A biological basis for generative learning in technology-and-science: Part I - A theory of learning. *International Journal of Science Education* (pages not yet known)

Schaverien, L. and Cosgrove, M. (in press b). A biological basis for generative learning in technology-and-science: Part II - Implications for technology-and-science education. *International Journal of Science Education* (pages not yet known)

Schaverien, L. and Cosgrove, M. (1997a). Learning to teach generatively. *Journal of the Learning Sciences 6*(3):317-346.

Schaverien, L. and Cosgrove, M. (1997b). A biological basis for generative learning in science. In C.E. Oxnard and L. Freedman (Eds.) *Perspectives in Human Biology: Human Trends and Lessons from the Past* (pp. 41-56). Perth: Centre for Human Biology and Singapore: World Scientific Publishing.

Schaverien, L. and Cosgrove, M. (1995). Technology learning 2: Towards re-awakening the technologists within primary teachers. *International Journal of Technology and Design Education 5*: 51-58.

Schmidt, W. H., McKnight, C. C. and Raizen, S. A. (1997). *A Splintered Vision. An Investigation of U.S. Science and Mathematics Education.* Dordrecht: Kluwer Academic Publishers

Sen, S. (1999). Towards new technologies for advanced teacher education: An autobiographical study. Unpublished Master of Education (Honours) thesis, University of Technology, Sydney, Sydney.

Seymour, E. (1995). Guest comment: Why Undergraduates Leave the Sciences. American Journal of Physics. 63(3):199-202.

Tobias, S. (1999). Some recent developments in teacher education in mathematics and science: A review and commentary. *Journal of Science Education and Technology 8*(1): 21-31.

White, A. and Klapper, M. (1994). An agenda for science education research. *Cognosos 3*(3): 1-10.

Wittrock, M. (1994). Generative science teaching. In P. Fensham, R. Gunstone and R. White (Eds.), *The Content of Science: A constructivist approach to its teaching and learning* (pp. 29-38). London: The Falmer Press.

Wittrock, M. (1974). Learning as a generative process. *Educational Psychologist 11*(2):87-95.

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Assessment of Distributed Group Working and Learning Through Use of Computer Mediated Collaborative Systems

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Abstract: The use of computer mediated support for collaborative work and learning can be used to leverage human and technological resources to increase the effectiveness of organizational response to change. Because evaluation of how effectively a CMS system supports a particular task environment continues to escape quantification, it is important to identify how and when users develop "workarounds" to adapt to such systems. In an experiment conducted to determine some of the critical success or failure factors related to use of CMS systems, it was found that users often develop creative solutions that compensate for deficiencies in CMS systems as required.

How do teams of individuals learn to use technology that is new to them while concurrently performing accustomed as well as new tasks? This is an important question since this is exactly what workers and students are being required to do with increasing frequency and at a constantly increasing pace. The growing pervasiveness of the WWW, the Internet, intranets, and extranets as media for expediting collaboration and partnering has taken center stage in business. Developing collaborative ways of working, learning, and communicating is becoming increasingly critical in education. There are numerous ways of designing collaborative working and learning computer mediated support (CMS) environments. Designed properly, computer supported collaborative work (CSCW) and computer supported collaborative learning (CSCL) systems can leverage human and technological resources not only to extend the effective reach of business and educational institutions, but also to increase their flexibility and their capacity for responding to change. This allows scarce or expensive resources such as brick-and-mortar facilities, experts, texts, and equipment to be put to the highest and best use.

Effectiveness Assessment

An overriding flaw in the design, deployment, and use of CSCW and CSCL systems has, to date, been a lack of tools and methods for assessing the effectiveness of such systems. Numerous human-computer interaction (HCI) issues are involved in their design. Defining a collaborative work or learning environment means taking into account the task(s) to be accomplished, the context in which the productive activity is to take place, and the CMS system itself. This overall environment is what supports the work or learning process that is geared to production of a unique outcome through an efficient process.

There is no one, easy, universally applicable way to assess the effectiveness of CMS systems. Limited and often erratic access to in-use systems restricts how much can be determined about how users have ultimately worked out an accommodation with the system that supports their need for individualization of their work activities. The impact of this adaptation process needs to be assessed in terms of effect on work and learning style as well as degree of satisfaction the user requires in order to successfully adapt to a CMS way of working or learning. While resistance to change is characteristic of the worker or learner who has already identified and implemented a suitable and reliably effective set of procedures for accomplishing a goal, an important area of concern with regard to designing new or improving in-place CMS systems is identification of the hidden aspects of work and learning processes that are key success factors in realizing the related goals. These enabling factors must then be integrated into the functional structure of the CMS. In this way, the user's needs are reconciled with the demands of the technology. Rather than the user bending to the needs of a rigid technology, the user's needs are accommodated and supported by the computer-mediated system.

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Rationale and Method

In an effort to identify some of the areas of work and learning situations that have contributed to lack of use and effectiveness of CSCW and CSCL systems, an experimental classroom scenario was designed to simulate a naturalistic distributed team work environment through use of the Internet, a local area network, scenarios and role taking. This design allowed analysis of qualitative and quantitative aspects of a number of dynamic teamwork variables (e.g., cohesiveness, conflict management, and various process gain and loss factors). More importantly, it allowed analysis of changes in learning and working styles of the members of each team as well as of the teams as a whole.

Teams worked in a computer laboratory setting where they simulated a distributed environment by using NetMeeting chat for all intra-team communication. The whiteboard function was used for logic diagramming and concept analysis. Team members shared a model-building application. Although this environment was set up to accommodate a reciprocal work style, one team regularly worked in a parallel style while another team used a mixed work style to solve decision-modeling problems as well as for collaboratively writing a final report.

The eighteen subjects in the study consisted of sixteen junior and senior undergraduate Information and Computer Science students and two master's level Engineering students enrolled in a course on CSCW in practice. The course contained elements of software analysis and design as well as practical experience with working in teams. Team membership was assigned based on a learning style inventory administered as a pre-test prior to beginning work on the first of two scenarios. This resulted in formation of two teams having four members and two teams having five members. Three of the teams were heterogeneous. One team was homogeneous.

The teams engaged in the design of decision models using software based on the analytical hierarchy process to help them structure their decision making. Two different kinds of scenario were used to test team reasoning and performance capabilities. The first scenario related to Y2K preparedness and the emergency response readiness of various municipal departments. The second scenario involved the design, implementation, and marketing of an ideal, user-tailorable CSCW system that could be used in a business or an educational environment.

For each of the two scenarios, each team was provided with experience working in each of four roles prior to a final "face-off" session. After these practice rotations, teams engaged in a "face-off" where they competed for budget or venture capital allocations based on the apparent efficacy of their decision model. Each team role was randomly assigned just prior to the "face-off." The design allows for analysis of within and between group differences in process, performance, learning, and outcome for each of the groups.

Initial Results

This Internet application-sharing interaction was the first distributed synchronous collaborative work in which any of the team members had engaged. Significant individual differences in working and learning styles emerged based on analysis of individual preferences as determined by administration of learning and work style surveys. While the learning style inventory was initially used to determine group composition, it was re-administered at the end of the course to determine the extent to which individuals had broadened the range of learning skills available to them as a result of the experiential knowledge-building treatment administered throughout the course. The treatment consisted of engaging students in interactive learning through simultaneous use of decision-making and collaboration software with which they were unfamiliar in a simulated distributed work setting. Comparison of pre-test and post-test results on the learning style survey indicated that all students had broadened their range of learning skills. Repeated measures of perceptions of software usability were also obtained via questionnaires. These revealed changes in perception of usability that were dependent more on performance reliability than on design features. Teams exhibited creativity in finding ways to work around software and equipment deficiencies in order to maintain productivity. Such "workarounds" indicate areas where adaptability of CMS systems to human needs can be improved. Repeated measures of teamwork variables were obtained via questionnaires focusing on individual team member perceptions of team performance, interaction, and results achieved. Although all teams achieved a high degree of cohesiveness, a higher degree of conflict would have benefited ultimate decision outcomes.

User-Centered Web Site Design: A Model for Development

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Introduction

This paper presents a model for creating user-centered educational and informational Web sites. Information design is the process of developing effective pieces of written or visual communication. While good information design stresses the importance of communication that clearly communicates an intended meaning, *user-centered* information design places primary emphasis on addressing the cognitive needs of the intended audience.

Distance education via the World Wide Web is becoming an increasingly popular form of instructional delivery. Because Web courses are often developed by teams of designers, a methodology for the collaborative development of educational Web sites can be a valuable tool for improving instructional effectiveness. This paper presents such a methodology and suggests areas of research to investigate the application of principles of user-centered information design to the development of effective instructional systems.

Theoretical Background

The field of information design embraces such diverse disciplines as business administration, computer science, cognitive psychology, graphic and typographic design, and technical communication. A user-centered approach to design is informed by principles of information theory and communication theory, information design theory, the findings of cognitive psychologists on perception and learning, and hypertext theory. Some of these theoretical considerations are briefly discussed below.

Information design theory draws on information and communication theory to suggest that designers structure information in ways that minimize "noise" and facilitate the transfer of meaning. Many factors, including personal characteristics, past experiences, and present feelings, can affect individual interpretation of sensory information (Stern & Robinson, 1994).

Jonassen (1993) states that hypertext resembles the associative network of human memory, and he suggests a technique of mapping the semantic network of an expert user. In such a map, concepts in the expert's mind become hypertext nodes, and the relationships among concepts become hypertext links. Vygotsky's (1978) sociocultural learning theory suggests that learning takes place as learners interact with more advanced peers and adults.

Using the notion of hypertext as a cognitive map, instructors can provide learners with a powerful tool for visually mapping their own representations of knowledge. Collaboratively-developed hypertext documents (cognitive maps) can also serve as sociocultural learning tools, providing learners the opportunity to "interact" with peers and expert users, even those who are geographically removed from the learner.

A User-Centered Model for Development

While *information design* is concerned with the development of effective pieces of communication, *information architecture* is the more far-reaching process of analysis, design, development, and implementation of a large-scale information product. The literature on information architecture suggests that Web site creation requires a systematic process of audience and content analysis; creation of detailed site diagrams and documentation; and production and implementation (Rosenfeld & Morville, 1998).

I propose that development of user-centered Web sites be guided by a four phase model: Design, Develop, Deploy, Document. This is a cyclical, iterative process, as illustrated in the following diagram:

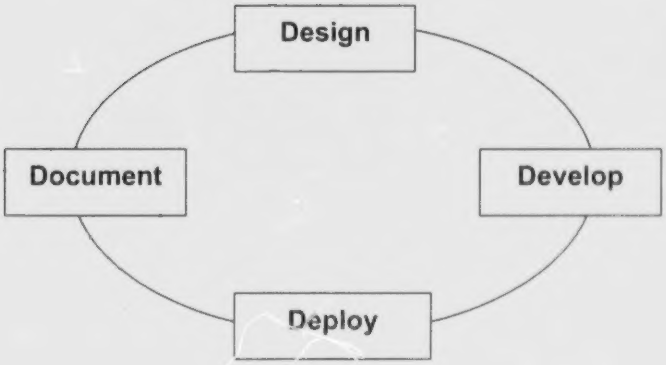

Figure 1: A user-centered model of Web site development.

In the **Design** phase, the designer performs needs analysis, audience analysis, and task analysis. The activities associated with this phase are identical to those found in traditional models of instructional design. In collaboration with the intended audience or the client, the designer develops initial prototypes and blueprints. After client approval, the project moves to the **Develop** phase, in which the development team builds the product according to the specifications developed during design. In this phase, the designer works with graphic artists and technical experts to build the site. As the product is developed, the design/development team meets with the client for discussion and negotiation of modifications, if needed. Upon client approval of the final product, it is moved to the **Deploy** phase. In this phase, the Web site is installed and made available to the target audience. In the **Document** phase, the design/development team assembles project documents and blueprints and presents them to the client to guide future product revisions. This documentation feeds into future Design phases, and the cycle continues.

Conclusion

The four phase model I have described may be viewed as a framework for research into the processes of creating user-centered information: design of information (needs, audience, and task analyses), development of information (writing, graphical production, page/screen layout, programming), deployment (implementation and evaluation), and documentation of the product (to guide future expansion and revision). However, a presentation as limited as this often brings up more questions than it answers. What are the precise activities that occur in each phase of the model? As this model is refined, detailed procedures for each phase must be worked out. What is the correct balance of theoretical and applied knowledge to prepare students to be designers of effective instructional Web sites? What should we teach students to prepare them to be good information designers in instructional settings? What are the best approaches to teaching these skills? Ongoing research, including the development of a graduate-level course on instructional applications of information architecture (Victor, 1999), is investigating the appropriateness of applying user-centered information design principles to the development of instructional systems.

References

Jonassen, D. H. (1993). Effects of semantically structured hypertext knowledge bases on users' knowledge structures. In C. McKnight, A. Dillon, & J. Richardson (Eds.), *Hypertext: A psychological perspective*. London: Ellis Horwood.

Rosenfeld, L., & Morville, P. (1998). *Information architecture for the World Wide Web*. Sebastopol, CA: O'Reilly & Associates.

Stern, R. C., & Robinson, R. S. (1994). Perception and its role in communication and learning. In D. M. Moore & F. M. Dwyer (Eds.), *Visual literacy: A spectrum of visual learning* (pp. 31-51). Englewood Cliffs, NJ: Educational Technology Publications.

Victor, S. P. (1999). Instructional applications of information architecture. In B. Collis and R. Oliver (Eds.), *Proceedings of the 1999 Conference on Educational Multimedia and Hypermedia*. Charlottesville, VA: Association for the Advancement of Computing in Education

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Templates for Generation of an E-Commerce Application

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Abstract: This paper presents an application that facilitates the implementation of electronic commerce sites. The application uses a series of templates or universal forms to accomplish this development. The forms are used to populate details needed for implementing an Electronic Commerce application. Businesses who are interested in having an online store can use this product to create or build an e-commerce application. The availability of such templates can enable small companies who do not have the IT support and expertise available to take advantage of this phenomena of e-commerce.

Introduction

E-commerce is becoming essential to today's business society. Essentially e-commerce is using electronic means to facilitate the buying and selling of goods and services between two parties. As the use of e-commerce becomes more prevalent in today's business market, it will be necessary for firms both large and small to utilize its services to attract and maintain their customer base and remain competitive. Dillon [1999] reports that worldwide E-commerce revenue will grow from $98.4 billion in 1999 to $1.2 trillion in the next four years and that the United States will continue to generate a majority of the dollars produced.

E-Commerce systems enable merchants to create electronic stores where they can sell their products and services globally over the Internet's World Wide Web (WWW). E-Commerce has allowed small companies to do business on the web and appear as competitive as any large organization. However, many small companies do not have the information technology (IT) support and expertise available to take advantage of this phenomenon. This paper presents an application of templates for generating an e-commerce site. The templates or universal forms incorporated in this application allow the population and customization of all the components needed for implementing e-commerce. Merchants who are interested in having an online store can use this product to create or build an e-commerce application.

Templates for Generation of an E-Commerce Application

The application provides two views of an e-commerce site, the merchant's view and the shopper's view.

The merchant's view facilitates the design and deployment of an e-commerce site. Components of the tool allow the merchant to customize the e-commerce interface for a specific business and to customize a database for catalog and client information. Functions within the merchant's view permit the specification of a business' logo, the specification of product categories, and the population of the catalog. This view is restricted to the merchant or store manager.

The shopper's view is the e-commerce public site which enables customers to buy products. The shopper can select items from the catalog for purchase. Customers can choose the activities that they want to perform from the shopper's menu shown in Figure 1.

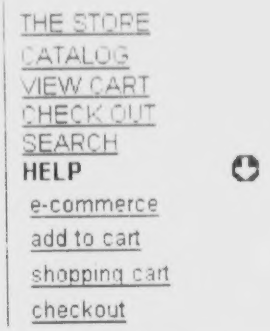

Figure 1: Shopper's Menu

The main page of the CATALOG presents the categories to the shopper. The shopper is able to select the category which is then expanded to reveal the details of each product within that category. This organization facilitates the customers' ability to locate and buy specific products. The customer can select any product and place it in the shopping cart.

The VIEW CART allows the shopper to view the contents of the cart as well as modify them. The shopping cart will hold any quantity of an item and will show both the unit and extended price of the item as well as the total cost of items in the cart.

The CHECKOUT requires each customer to provide billing and shipping information. The customer needs to confirm the contents of the order and accept the final total. The order is then recorded in the database for later fulfillment.

Technical Description

The templates for generation of an e-commerce application were developed using Active Server Pages (ASP). ASP is a scripting environment for the creation of dynamic Web-based applications. ASP with Internet Information Server (IIS) 4.0 provided a flexible method to interact with the ODBC compliant database used in implementing this application.

Reference

Dillon, Nancy. "U.S. Still Generates Majority of E-commerce Dollars," Computerworld (Online News, 07/08/99) http://www.computerworld.com/home/news.nsf/all/9907084eglobal

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InterLearn – an Internet Learning Support Environment for Collaborative Learning

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This paper outlines the design and development of an online learning and teaching environment named InterLearn. Designed by Monash University's Centre for Higher Education Development to deliver its Graduate Certificate in Higher Education and other Staff Development topics, it uses a database approach to provide learners with their own 'worksites' and online learning activities.

Based on notions of collaborative learning and constructivist approaches, InterLearn provides students the functionality to search and read each others responses to online activities and collaborate in forming a shared understanding of ideas and concepts (Fig. 1).

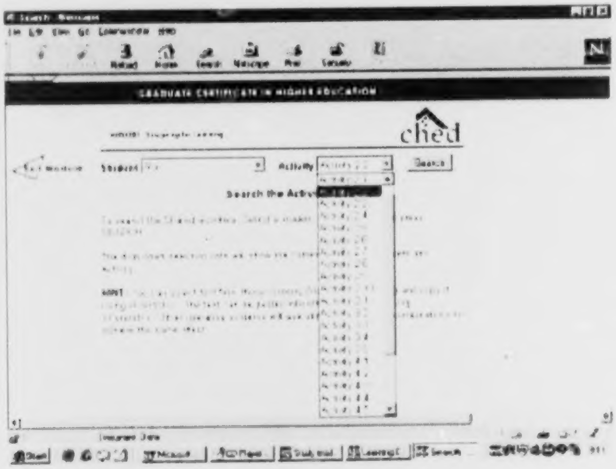

Figure 1: Activity search feature

Students may also edit or update their responses to activities whenever they enter their 'worksite', a secure and customised teaching and learning area for the student. Other functions include discussion group, news area and a maintenance module to enter student details and assign passwords and login identification (Fig. 2).

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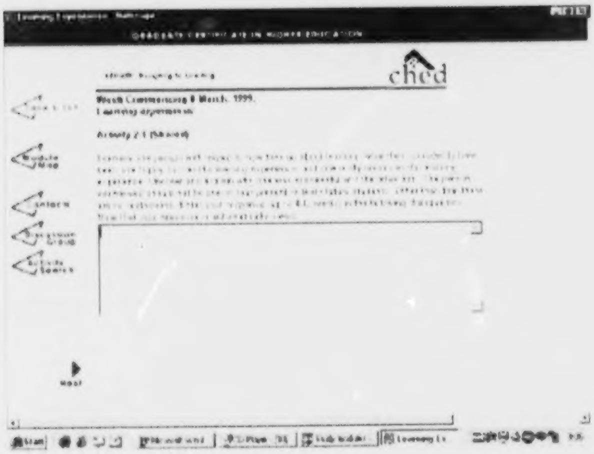

Figure 2: Features including activity editing

Trialed this year in the Graduate Certificate in Higher Education, interim evaluations have indicated that the approach is welcomed by course participants. Further development is now planned to incorporate Staff Development topics and remaining subjects of the Graduate Certificate in Higher Education. Initial feedback by students (themselves University teachers) to the online learning environment is encouraging with remarks such as:

> "I am particularly happy with the activity system adopted in the course under different modules. The activity system allows me to build my knowledge gradually in a very flexible way. It also allows me to share others experience and gain from their experience and knowledge. Another good reason is that I can practice what I learned from others in my own class and add that experience to activities."
>
> "Reading the various responses of other people is a great way of getting a better picture of what the class think as a whole."
>
> "The opportunity to reflect about my teaching practices. This is facilitated by a good choice of on-line and text resources which are readily available. The flexibility of the subject delivery. It would be very difficult to attend classes on a regular basis while having to undertake all my other academic activities. I can access the subject material from any of my offices (I operate on two campuses) and from home, and because I can choose the time to undertake the activities – away from telephones and interruptions of all sorts – the reflection time is more effective."
>
> "The course had stimulated reflection on my own teaching practice and I can see some changes in my teaching style in response to this. It has also encouraged a small group of us to share all experiences and fostered the creation of a small "teaching" community."

InterLearn is seen as one teaching tool that can be used to develop online learning environments that are more interactive and independent. A further outcome of the work so far is that the interactivity between students in on-line courses can be stimulated without adding substantially to the overall teaching load. Although the functionality of InterLearn will not be significantly extended, some minor refinements are currently being undertaken including:

1. Multiple searching of responses
2. To facilitate searching, only completed activities available if searching by name or vice versa
3. Enhanced features for activities including formatted text, tables, images, video and sound.
4. Maintenance module: Check links for validity and reporting function
5. Maintenance module: View of students completed activities for teaching staff including assessed activities

At this stage it is planned to have these refinements available in late 1999.

A Framework for Evaluating Web-based Instruction

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Abstract: An evaluation framework based in work by Stufflebeam and Patton is proposed and illustrated for use in evaluating web-based instruction. Implications for building a similar framework into web-based instructional design are explored.

There is a flurry of effort to use the World Wide Web instructionally. A few educators discuss the value of these efforts and even fewer actually evaluate their web-based instruction to ascertain its merit and/or worth. See a summary of this literature at http://msc.byu.edu/ipt/williams/literature.html.

Do these evaluations help? Are we learning what we ought to know about the Web as an instructional medium? Will potential evaluation information users benefit from these inquiries? This presentation will propose and illustrate a framework for improving evaluations of instruction offered via the internet based on Stufflebeam's Context, Input, Process, Product (CIPP) model and Patton's Utilization-Focused Evaluation approach. Examples of evaluations of several instructional development projects at a major university will clarify the framework's utility.

The Framework

In planning, conducting, or reporting an evaluation, evaluators need to account for two important kinds of background information to make their evaluations useful: the context for the thing being evaluated (the evaluand) and the context for the evaluation process being used. Evaluand context information includes information about the request for the evaluation, if any, historical information surrounding the evaluand that might be relevant, and reviews of literature pertinent to the evaluand. For example, in most of the evaluations of web-based courses at Brigham Young University, the central administration has requested evaluations be done, each course has a unique history which has shaped the creation of the course for use on the web, and the evaluation literature cited earlier along with content-specific literature unique to each course is relevant to their evaluations. Examples from some of these evaluations are cited below.

Evaluation process context information includes the approach to evaluation that is being used and a rationale for that approach in each situation. Many approaches to evaluation have been proposed and employed since the 1960's when evaluation was mandated by the United States congress in conjunction with funds allocated for educational programs. The approach taken will determine to a great extent the kinds of information that can be gathered. So it is important for the evaluator to be explicit about the approach to be taken so the persons considering the evaluation proposal or reading the completed report can better interpret the results and their utility.

Presented in the links below are some fundamental elements of one approach to evaluation that we are currently promoting among units at Brigham Young University for use in the evaluations they are conducting. Our rationale for proposing use of this approach is that it combines a broad perspective to the life of most kinds of evaluands, ranging from organizations to instructional products as first proposed in the early 1970's by Stufflebeam and others [Stufflebeam et al 1971] (see http://dlc.byu.edu/williams/cipp.jpg) with a user-focused approach that Patton has articulated (Patton 1997) for almost as many years.

The proposed evaluation framework (see http://msc.byu.edu/ipt/williams/661Fall99/UFE-CIPP/index.htm) combines these approaches into a comprehensive model which uses a basic logic (Scriven 1981) of comparing what is to what ought to be much as one would with a pan balance (see an elaboration at http://msc.byu.edu/ipt/williams/661Fall99/panbalance.pdf) and a further elaboration of these ideas at http://msc.byu.edu/ipt/williams/661Fall99/framework.pdf which outlines a process for carrying out evaluations of many kinds of evaluands for many different kinds of audiences. Material at http://www.wmich.edu/evalctr/jc/PGMSTNDS-SUM.htm describes published standards for judging evaluations or meta-evaluation as proposed by Michael Scriven and elaborated by Stufflebeam.

The framework organizes the interests, questions, values, and participation of potential evaluation users and stakeholders around four types of evaluation:

1. CONTEXT evaluations which investigate the socio-political, organizational, and other contextual variables associated with the need for instruction using the internet.
2. INPUT evaluations which compare alternative inputs or means for meeting the needs, including web-based instruction.
3. PROCESS evaluations which formatively assess the planning, design, development, and implementation of instruction to improve it.
4. PRODUCT evaluations which allow summative judgments to be made regarding the quality, utility, and value of existing instruction.

Ideally, evaluation of all four types will occur simultaneously and repeatedly throughout the life of an organization which has multiple instructional development projects, programs, initiatives, courses, and so on coming and going. As part of each evaluation, the following activities should be conducted by qualified participants (sometimes internal to the organization and sometimes by external consultants):

1. Clarify evaluation users (who cares?), such as administrators, faculty, students, designers, etc.
2. Invite users to clarify what the evaluand (thing being evaluated) is (what do they care about?). For example, various contextual variables, alternative inputs, elements of the process, or alternative products or dimensions of those products could be considered.
3. Work with users to clarify criteria or indicators of success to judge the evaluand against (what is success?). For example, the process should cost less than the status quo, the course should teach more people faster at a higher level of performance, etc.
4. Work with users to clarify questions they have and what they will do with results (what to ask?).
5. Use steps 1-4 to determine the inquiry methods, needed resources, timeline, costs, etc.
6. Meta-evaluate the plan, the process, and the actual evaluation formatively and summatively on a continual basis to improve it while improving the evaluands.

Examples

Example evaluation studies based on this framework at Brigham Young University may be found at http://msc.byu.edu/ipt/williams/661Fall99/Studies.htm. Depending on the time available, one or more of these examples will be reviewed during the presentation.

Implications

By building evaluation integrally into web-based instructional design, we at Brigham Young University believe we will not only improve the instruction but will also involve all the potential stakeholders in clarifying their interests in the instruction and its evaluation so they want to use the results to improve their performance as it relates to the instruction.

Participant buy-in is crucial to the success of educational evaluation and thus to the success of the courses and other evaluands evaluated. The framework described in this presentation promotes buy-in by everyone concerned with web-based instruction.

References

Patton, M. Q. (1997). *Utilization-focused evaluation : the new century text.* Thousand Oaks, Calif. : Sage.

Scriven, M. S. (1981). *The logic of evaluation.* Inverness, CA : Edgepress.

Stufflebeam, D. L., Foley, W. J., Gephart, W. J., Hammond, L. R., Merriman, H. O., & Provus, M. M. (1971). *Educational evaluation and decision-making in education.*, Itasca, IL: Peacock.

Pedagogical Possibilities of EMail Communication

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Abstract: Assumptions about email often fan faculty fears about the changes that technological advancements are bringing to the field of education. However, when we recognize that email can be adapted for use within various pedagogies, and that students' expectations will inevitably make it an integral part of our teaching practices, we will realize that it is time to seriously explore the pedagogical possibilities of electronic communication.

Some time after I began writing this talk, I saw an announcement for a seminar on teaching email as a writing genre on the AAHE-affiliated TLT Group listserv. Posting a message in response, I said that I have always thought of email as a form of expression closer to freewriting than anything else that we teach in the composition classroom, but I agreed with the seminar leader, Trent Batson, that some rules were necessary to maximize the potential benefits of this new form of communication. Batson used a wonderful metaphor to convey his sense about these rules: he suggested that they would be "patterns of usage that people develop over time," or "footpath rules, letting people walk on a campus for a while and then laying concrete where paths develop." After my post, someone very quickly responded with another message, cautioning against this kind of dialogue about ground rules. Assuming that a discussion about using email to communicate with students necessarily implies distance education, the writer argued that rules would make it harder for "distance learners" to create a sense of community in an online environment.[1]

Initially, I was struck by the writer's immediate assumption about the connection between email and distance education. I have not yet taught an online course, and indeed, I have not yet even used email in a class in any systematic way. I do, however, put my email address on course syllabi and tell students that I check email more frequently than voice mail. I also encourage students to participate in a listserv or a mailing list that I sometimes set up for smaller classes. And already, I have discovered that this informal use of email has added to my teaching in ways that I had not expected before.

Email, I have found, offers students various learning opportunities, which they are quick to discover and take advantage of on their own, sometimes in rather creative ways. Students have sent me email to clear paper topics, bounce off ideas, and receive feedback on early drafts. After a Shakespeare course ended, one student continued to reflect on her responses in the final exam, not that there was any expectation her grade would be affected, and sent me something along of the lines of "This is what I wish I had said. . . ." In a survey of English literature class, a student who was about to transfer to a different school not only asked about her grade, but also asked about her performance in the final exam, whether she had improved in the specific areas that I had commented on in a mid-term. Other students in an Asian American lit. class have continued to send me email, as they continued to reflect on class discussions that occurred at different points in the semester. And finally, some students have also used email to tell me about difficulties they were experiencing in other classes. From my perspective, receiving students' email gives me a chance to reflect on what they say, both before and after I see them in person. It enables me to prepare more carefully considered responses than I otherwise would be able to come up with in class. It also allows me to go back and reread their messages if I find myself wondering whether a response or advice that I'd given was appropriate.

I am often surprised and/or delighted by the email messages that I receive from my students. One of the more memorable ones begins something like this: "Hi, I was painting and I started to think about what we were saying about Shakespeare in class the other day. . . ." But at a faculty meeting this semester, I heard a startling story about using class listservs from a colleague who teaches business law and ethics. He said that he keeps a file of student papers for a course he regularly teaches, and one year he found a paper that was so obvious and flagrant in its plagiarism that he wondered how the student could have expected to escape detection. He wondered how he should respond and finally resolved his dilemma by posting a harsh reprimand to the offender on the class listserv, without naming the student. The next morning when he arrived at his office, he saw one of the best students in the class waiting for him. The student sat down in his office, and with tears in his eyes, confessed his crime. But of course, this student was not the culprit that my colleague had in mind; this student's plagiarism had been so subtle that it had escaped detection. Stunned by the unexpected development and his discovery of this potential use of an electronic bulletin board, my colleague briefly debated the ethical implications of posting a similar message every semester, before any cheating had occurred in a class.

Whenever we venture into uncharted seas, we are bound to discover the unexpected, and sometimes we even have to weather some storms. To many faculty, any talk of using technology in the classroom still means an attack on and attempt to replace sound, traditional pedagogical practices, which returns me to the anecdote with which I began my talk. Some people assume that email communication necessarily implies distance education. Some people are reluctant to impose any rules which might restrict the liberties of expression made possible by email. And sometimes, some people would even consider any effort to critique student email styles, such as gratuitous use of profanity, as akin to censorship and a desire to ban the teaching of Darwin's theory of evolution. These kinds of assumptions and concerns, of course, only underscore the need for faculty to hold more conversations about our pedagogies and what it is that we hope to teach our students.

In reviewing the email messages that I have collected, it occurred to me that mostly they have come from students who I see regularly. The value of email communication, then, is that it deepens and strengthens the relationships that I develop with my students: it does not replace classroom interaction. And this point, I think, cannot be over-emphasized, that rather than supplant in-class discussions, electronic conversations actually supplement and enhance face-to-face teaching.

In the rest of my talk, I'd like to focus on how email worked in the Asian American lit. class that I taught last semester. A few days ago, a student remarked to me that that course was one of the best classes she'd ever taken, because she had found great friends there. I suspect the small class size was a significant factor, but I would also like to believe that the students' practice of posting regularly to a class mailing list contributed to their sense of community. Some more thoughtful students developed the habit of writing long, reflective essays as they continued to think about class material after they left the classroom. Other students posted their in-class writing exercises, which I encouraged as a way for quieter or more passive students to share their thoughts with the whole class. I told the students that their contributions were voluntary, but the effort would count as a kind of class participation. Many students took me up on this offer, and consequently the entire class was able to enjoy reading the class work that is usually only submitted to the instructor.

This method of continuing class discussions enabled us to transcend the time and space limitations of a physical classroom. It also gave us new ways of discussing sensitive and controversial topics such as religion, race, and cultural differences. The electronic forum allowed us to diffuse the tension and sense of discomfort that often accompany such conversations; and paradoxically, the distance in time and space also enabled us to cultivate a sense of intimacy as students freely shared their thoughts without the fear of face-to-face confrontations. In many of our virtual conversations, the students impressed me with their willingness to reveal deeply held convictions, courage in challenging a peer's apparent stereotypical thinking, and ability to communicate in an articulate and compelling fashion. The electronic forum also gave me a way to respond to students privately and quickly if necessary, and I have no doubt that it facilitated many difficult discussions that otherwise would not have occurred.

Since this medium of communication is ubiquitous in contemporary culture, most students instinctively know how to appropriate its capabilities and adapt them for their own use. For example, many naturally know how to take advantage of email's "Q and C" feature,[2] which gives them the option to respond very precisely to another writer's remarks by quoting exact words and commenting on them. Even those who initially think themselves computer illiterate pick up requisite skills very quickly and wonder how they ever got along without email. Students like using email because it is informal and easy; it can accommodate different learning styles; and its immediate transmission improves their chances of getting fast feedback from instructors. So it would be logical to think that if faculty integrate email communication into our teaching, students would be inclined to write more thoughtfully and reflectively, because they would be writing with a purpose.

Many faculty still regard with anxiety the sea changes occurring in education brought about by the advent of technological advancements. But we must acknowledge the fact electronic communication will inevitably become a part of our pedagogies, as more and more students enter our classrooms with the expectation that we will be accessible through email. Today, if students don't see it on the syllabus, they will ask, "What's your e-mail address?" Soon enough, they will also be asking, "And what's your URL?"

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[1] Email exchanges in AAHESGIT87, AAHESGIT89, and AAHESGIT91. Copyright 1999 Steven W. Gilbert. http://www.tltgroup.org/listserv. August 18, 23, and 26, 1999.

[2] Stevan Harnad's term, quoted in AAHESGIT101. Copyright 1999 Steven W. Gilbert. http://www.tltgroup.org/listserv. September 2, 1999.

Learning the Internet through the Internet: A Case Study

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Abstract: The Internet can be a delivery tool, a search tool or a development tool for any WWW-based Instruction. But without knowing the basic services of the Internet, it is difficult to use it effectively. Thus, the main purpose of this study is to develop a WWW-based Internet Tutorial including visual examples in order to teach the Internet Tools and analyze this tutorials' effectiveness. At the end of the study, the findings led to a profile of the participants' (a) attitudes toward computers; (b) achievement about the Internet; (c) perceptions' about the Internet Tutorial.

Introduction

Integrating Internet and World-Wide Web into education has come up with some problems. It was really a huge world to explore. Since every student who tries to meet this technology was getting lost in this world, the basic question was "how to teach the basic Internet tools to students".

Putting information together and creating WWW-based instruction is very simple by using WWW tools. But, there are some points which a designer or teacher must be careful while developing the instruction. Most important ones are: (a) Defining the domain and provide content; (b) Designing instruction and (c) Evaluation (McManus, 1996). In the future, with increasing experience and research studies we will be guided more effectively. But for the time being, the development of technology is so rapid that there is neither enough research studies nor experiences for us to reference (Kearsley, 1997).

The purpose of this study was to develop a WWW-based Internet Tutorial, which can adapt to students with different backgrounds, prior knowledge of the subject and learning goals. So that, any student apart from his age can learn the Internet via using the WWW-based Internet Tutorial.

Design of the Study

The main purpose of this research is to investigate the effectiveness of the tutorial, which is developed to teach the basic Internet Concepts via World Wide Web. At the end of the research, the subjects' achievement will be investigated. The second purpose is to investigate the effectiveness of applied materials in terms of student demographics (gender difference and school factor) both quantitative and qualitative, in order to see if any difference occurs in terms of attitude towards computers and the achievement of the Internet concepts.

The Computer Attitude Scale Test was administered online as a pre-test at the beginning of the treatment to control students' attitudes toward computers. Tests during the treatment after each topic and a general test after the treatment was administered online as a post-test to measure the students' achievement in learning the services of the Internet. And finally, an open-ended questionnaire was administered to randomly selected students from each three school, in order to see qualitative results. The subjects of this study for quantitative analysis were totally 80 students. 45 students from two high school college students and 35 students from freshman. The open-ended questionnaire was administered to randomly chosen 11 students from high school college students and 5 students from freshman. Namely 16 students were the scope of qualitative analysis.

Instruments and Treatment

Before the treatment, the Computer Attitude Scale (CAS) was administered to the students. This scale was originally developed by Loyd and Gressard (see Loyd, B. H. and Gressard C. 1984) and then, translated into Turkish and analyzed by Berberoðlu and Çalýkoðlu (see Berberoðlu, G. and Çalýkoðlu, G. 1992). In the treatment part, developed WWW-based Internet Tutorial was administered. Since it is thought that basic services of the Internet can be learned online without a teacher by every student herself, the WWW-based Internet Tutorial used in this study was prepared using some WWW Tools by the researcher. The tutorial is prepared in Turkish, because of the lack of Turkish Documentation in this area. Then during and after the treatment Internet Tools' Achievement Test (including 8 short and 1 final test) was administered to students. This test was developed by the researcher. To have qualitative results an open-ended questionnaire was developed by the researcher. The questionnaire was distributed to 16 (6 females, 10 males) students who was randomly selected by the researcher and agreed to participate in it.

At the beginning of treatment, the answers to the Computer Attitude Scale were taken from the students online. Then the instruction i.e. WWW-based Internet Tutorial was administered to the students. The only explanation made by the researcher to the students was the goals and objectives of the tutorial. During the treatment, students answered 8 topic tests and when they finished the tutorial they answered a general test, that were all online. After the treatment, open-ended questionnaire was given to randomly selected students.

Data Analysis and Results

In this study, both quantitative and qualitative research techniques were used. For *Quantitative Analysis* the results of Computer Attitude Scale and Internet Tools' Concepts Achievement Test were used. For *Qualitative Analysis* the results of open-ended questionnaire were used.

Based on the statistical analysis and results which was presented in the previous sections, the following results have been reached:

- Freshman got higher scores in terms of general achievement than high school college students.
- There was no relationship between attitudes toward computers and general achievement.
- Boys were found out to be more successful than girls in terms of general achievement. And also boys were found to have more positive attitudes toward computers than girls.
- The WWW-based Internet Tutorial was overall successful and adding more pictures, animations and video films can increase the effectiveness of the tutorial.

References

- McManus, Thomas F. (1996). Delivering Instruction on the World Wide Web. University of Texas at Austin. Internet WWW page at URL: http://ccwf.cc.utexas.edu/~mcmanus/wbi.html
- Kearsley, G. (1997). A Guide to Online Education. Version: 7/1/97. Internet WWW page at URL: http://www.gwu.edu/~etl/online.html
- Jonassen, D.H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Eaglewoods, NJ: Merill/Prentice Hall.
- Yýldýrým, S. (1997). Effects of an Educational Computing Course on Preservice and Inservice Teachers Attitudes Toward Computers. Unpublished Doctoral Dissertation. University of Southern California. Los Angeles.
- Web Based Instruction Tutorial. Internet WWW Page at URL: http://www.uwf.edu/~coe/tutorials/technolo/webinstr/webinstr.htm
- Miles, M. B. and Huberman, A. M. (1994). *Qualitative Data Analysis: An Expended source book*. Thousand Oaks: Sage Publications.
- Yýldýrým, S. and Kiraz, E. (1999). Obstacles in Integrating Online Communication Tools into Preservice Teacher Education: A Case Study. *Journal of Computing in Teacher Education*. 15(3), 23-28.
- Loyd, B. H. and Gressard C. (1984). *Reliability and Factoral Validity of Computer Attitude Scales*. Educational and Pschological Measurement, 44.
- Berberoðlu, G. and Çalýkoðlu, G. (1992). The construction of a Turkish computer attitude scale. *Studies in Educational Evaluation*. V.24. Issue 2 (pp. 841-845).

Using Virtual Teams in an On-line Software Engineering Class

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Introduction

This paper addresses the issues involved in creating and facilitating virtual teams in an on-line software engineering class. It includes an epistemological foundation for creating virtual teams, a detailed description of the process, an overview of the key issues and challenges that were encountered, and an overview of the technology.

In recent years, the availability of technology has increased significantly, making on-line distance education classes a viable option for many students. Through tools and strategies such as videoconferencing, file exchange, electronic libraries, virtual cafes, whiteboards, debates and opinion polls, role-taking activities, and student dialogues, there is ample opportunity for learners to apprentice each other on-line (Bonk & Cunningham, 1998). As such, it is necessary to develop classes based on a foundation that recognizes the potential for collaborative technology.

Theoretical Background

Vygotsky (1978) stressed the specific social nature presupposed by human learning in his description of the zone of proximal development. From this perspective a learner is capable of solving more difficult problems in collaboration with a peer than what can be done independently, which outlines the importance of interaction in facilitating internal developmental processes (Vygotsky, 1978). A major tenet of Vygotskian psychology is that social interactional, cultural, institutional, and historical contexts all play a role in the development of an individual's mental functioning (Bonk & Cunningham, 1998).

A sociocultural epistemology builds on Vygotskian psychology by defining effective teaching as that which falls within the zone of proximal development, thus stressing the importance of providing opportunities for collaboration and mentoring of students (Gredler, 1992; Hedegaard, 1990; Moll & Greenberg, 1990; as cited in Althauser & Matuga, 1998). Accordingly, students are encouraged to explore new ideas and apply their knowledge and skills while sharing their mental processes (Althauser & Matuga, 1998). Through this collaboration, the individual learners and the team are able to generate solutions, solve problems, and gain insights that are beyond their individual capabilities (Bonk & Cunningham, 1998).

Description of Current Research

The Software Engineering Department at the University of Houston-Clear Lake responded to a call to develop on-line distance education classes. In the initial meetings, it was established that collaboration must be a major component, since software engineering is a team-oriented profession. With this idea in mind, the department opted to move toward a sociocultural epistemology because of its emphasis on building a collaborative network of learners, recognizing the value of different ideas in understanding reality. For the initial pilot of the program, the department selected a course in software project management to go on-line. The development team was established, consisting of an instructor and instructional designer, with a Web developer and graphic designer assisting.

A modified Dick and Carey (1976) model was followed to cultivate a unified, methodical approach for development of the curriculum. At the initial level, a list of outcomes was developed, reflecting the abilities that students must posses at the end of the course. Since the material is procedural in nature, the instructional analysis resulted in a clear list of learning objectives. At this point, the development team analyzed the progress, and made some decisions about how these objectives could be attained in a team environment. Rather than developing a series of small tasks, the team choose to use two parallel semester long assignments, comprised of an individual project and group project. All of the tasks on the group side were contributory in that they were designed to specifically prepare the student to work on the individual components after resolving issues collaboratively. In this way, the assignments were designed to scaffold the learning within the zone of proximal development (Matuga, 1998). A flow chart was designed showing how the assignments coordinate throughout the semester, and assessment rubrics were created. At this point, the group determined what content was necessary to support the activities in the flowchart, and short tutorials were designed to introduce students to the more classical ideas of software engineering.

Since the class will be offered in an on-line format, the issue of facilitating the virtual team has been an important part of the process since much of the success of the class depends of the groups working through the project collaboratively. Palloff and Pratt (1999) describe seven steps that help build a virtual community including clearly defining the purpose of the group, creating a distinctive gathering place, promoting effective leadership from within, defining the norms and a clear code of conduct, allowing for a range of member roles, facilitating subgroups, and allowing members to resolve their own disputes.

With these ideas as a guiding principle, a basic structure for the groups was defined with clear roles and responsibilities for each person. All teams have a project manager who is responsible for reporting the progress to the instructor, coordinating the work of the other team members, and helping to develop the end product. Each of the other team members has responsibility for a specific area within the field of software engineering: development, testing, build and integration, and system engineering. All of these areas overlap, and require a great deal of interplay. The teams have a unique software problem to solve written in the form of an RFP (Request for Proposal), which basically outlines the needs that the software must fulfil. The specific purpose given to the group helps the members to naturally establish a sense of community (Berg, 1999).

The department elected to use WebCT; a Web-based program designed to facilitate on-line classes. As a part of the structure of this program, each team has its own discussion board, chat room, and area to post presentations. In this way, students have the ability to meet their own needs for communication and, the technology is available to them at all times, empowering the team to make their own decisions about meetings, responsibilities, and timelines.

Data Gathering and Analysis

The pilot of the class will be taught on-line in the Spring, 2000. Primarily the students are working at the Master's level, and many of them are employed in an engineering-related field. It is anticipated that students will span a large geographic area surrounding the university and will come from a variety of backgrounds. An instrument for formative evaluation is under development to assess the achievements of the program. This instrument will measure the attitudes of the students in regard to their virtual teams. A measurement will be taken at the beginning of the group project and again at the end. This will help to determine what changes may be necessary to improve the course before it becomes a more permanent fixture in the distance-education curriculum.

References

Althauser, R., & Matuga, J. M. (1998). On the pedagogy of electronic instruction. In C. J. Bonk & K. S. King (Eds.), *Electronic Collaborators: Learning Centered Technologies for Literacy, Apprenticeship, and Discourse* (pp. 183-208). Mahwah, NJ: Lawrence Erlbaum Associates.

Berg, G. A. (1999). Community in distance learning through virtual teams. *WebNet Journal, 1*(2), p 33-39.

Bonk, J. C., & Cunningham, D. J. (1998). Searching for learner-centered, constructivist, and sociocultural components of collaborative educational tools. In C. J. Bonk & K. S. King (Eds.), *Electronic Collaborators: Learning Centered Technologies for Literacy, Apprenticeship, and Discourse* (pp. 25-50). Mahwah, NJ: Lawrence Erlbaum Associates.

Dick, W., & Carey, L. (1976). *The systematic design of instruction.* Glenview, IL: Scott, Foresman and Company.

Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom.* San Francisco: Jossey-Bass Publishers.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Panels

DSM-CC Extension for MHEG-5 Applications on the Web

Abstract: In this paper, we extend DSM-CC for distribution of applications and providing additional services based on MHEG-5 via web. Proposed extension defines mapping between MHEG-5 to CORBA. It can support user and resource controls, real distribution of application servers and providing additional multimedia service facilities.

1. Introduction

Network technologies and multimedia are being popular. There are new requirements for mechanism to interchange and present multimedia and hypermedia information on the network. Also we have required mechanism to process real-time user interactions. But, the web has poor ability about those. The MHEG (Multimedia Hypermedia Encoding Expert Group) standard defines the representation and encoding of multimedia and hypermedia information for interchange between various applications [ISO97].

The MHEG-5 standard is the fifth subset of the MHEG standard. It defines some classes in detail. Those classes are appropriate to some applications such as video on demand, audio on demand, interactive TV and hypermedia navigation [ISO97].

As defining only final form for transmission and representation, MHEG-5 is currently used as simple interactive multimedia presentation. Regard of its various application areas, an MHEG-5 application will require formal distribution of contents and additional security services such as billing, authentication, authorization, etc.

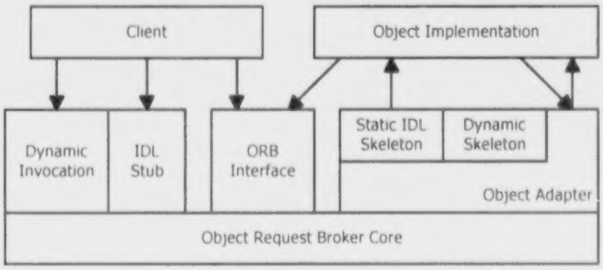
OMG (Object Management Group)'s CORBA (Common Object Request Broker Architecture) [OMG98] can provides those facilities for MHEG-5 applications. In this paper, we define mapping between MHEG-5 to CORBA. We extend DSM-CC (Digital Storage Media Command & Control) [ISO98] for distribution of applications and providing additional services based on MHEG-5.

2. Consideration of International Standards

In this chapter, we consider the international standards, CORBA, MHEG and DSM-CC, for distribution of interactive multimedia applications.

2.1 OMG's CORBA

The CORBA (Common Object Request Broker Architecture) is structured to allow integration of a wide variety of object systems [OMG98]. Figure 1 shows the structure of an individual Object Request Broker.



[Figure 1] The CORBA architecture

The Client is the entity that wishes to perform an operation on the object and the Object Implementation is the code and data that actually implements the object. The ORB is responsible for all of the mechanisms required to find the object implementation for the request, to prepare the object implementation to receive the request, and to communicate the data making up the request.

The interface the client sees is completely independent of where the object is located, what programming language it is implemented in, or any other aspect which is not reflected in the object's interface. To make a request, the Client can use the Dynamic Invocation interface or an OMG IDL stub. The Client can also directly interact with the ORB for some functions. The Object Implementation receives a request as an up-call either through the OMG IDL generated skeleton or through a dynamic skeleton. The Object Implementation may call the Object Adapter and the ORB while processing a request or at other times.

2.2 The MHEG standard

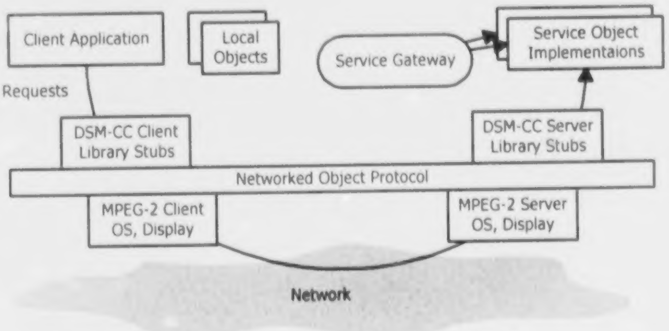
MHEG-5 provides a framework for the distribution of interactive multimedia applications across minimal resource platforms of different types. An MHEG-5 application resides on a server, and as portions of the application are needed, they will be downloaded to the client. In a broadcast environment, this download mechanism could rely, for instance, on cyclic re-broadcasting of all the application [ISO95].

A minimal MHEG-5 runtime environment has to provide an entity for decoding of the MHEG data structures and an entity called MHEG engine, which parses and interprets the MHEG-5 objects. The engine also communicates with the local presentation environment and the MHEG-5 objects. It responds to the events initiated by the application or the user in the application specific way. A MHEG application is always event driven.

An MHEG-5 application consists of Scene objects and objects that are common to all Scene within an Application object. At most one Scene is active at any one time. This is the part of the application that has to be loaded on the clients' system. Navigation in an application is done by transitioning between Scenes. A Scene contains a group of objects, called Ingredients, which represent information. The content data is typically not part of the encoded Scene object. Instead, content data can be referenced and stored externally.

2.3 Digital Storage Media Command & Control, DSM-CC

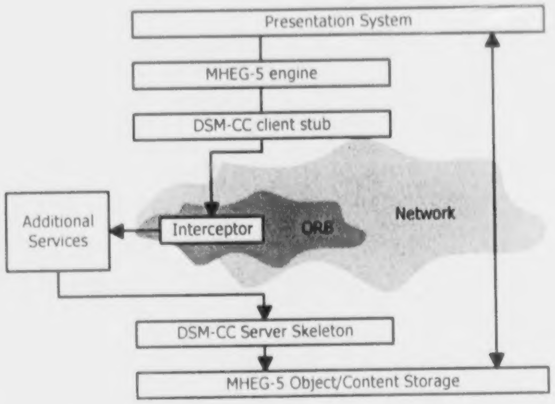
DSM-CC systems are composed of client using service, SRM (Session and Resource Manager) managing needed session and resource when it is provided with service, and server providing service [ISO98]. The composing entities have U-N (User–Network) signal that connect client and SRM, server and SRM and U-U (User–User) signal. DSM-CC describes a command for control of digital storing medium and concrete procedure. Primitive defined by DSM-CC is able to divide U-N (User-Network) and U-U (User-User) primitive. Figure 2 displays DSM-CC client/server system architecture.


Client Application
Local Objects
Service Gateway
Service Object Implementaions
Requests
DSM-CC Client Library Stubs
DSM-CC Server Library Stubs
Networked Object Protocol
MPEG-2 Client OS, Display
MPEG-2 Server OS, Display
Network

[Figure 2] DSM-CC client/server architecture

3. System Design

Figure 3 displays composition of multimedia service system including extended DSM-CC protocol. Extended DSM-CC protocol is able to use event, security, transaction, life cycle, and naming service.


Presentation System
MHEG-5 engine
DSM-CC client stub
Additional Services
Interceptor
ORB
Network
DSM-CC Server Skeleton
MHEG-5 Object/Content Storage

[Figure 3] Proposed architecture

3.1 Interface Design

DSM-CC U-U primitives can operate on the CORBA system environment and support RPC and defines OMG IDL to operate language and protocol independently. Client applications provide server environment with independent interface using DSM-CC library and connect service gateway of server. Table 1 defines interface and primitives of DSM-CC U-U.

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[Table 1] DSM-CC U-U primitives

Interface	primitive	Interface	primitive
dsm.Service	open	dsm.Stream	open
	close		close
dsm.Directory	open		play
	close		pause
	read		scanForward
	clean		scanBackward
dsm.File	open		jump
	close		status
	read	dsm.DBClass	list
	write		getSchema
	getData	dsm.DBField	getValue
	getSize	dsm.DBSQL	exec

User-User interface separate the essential functions, which are a minimum, demand item and the optional extended function. On the proposed architecture, extend function of life cycle, security, and event use CORBA service. As DSM-CC U-U primitive has service connection, directory service, stream, file, and database access, directory service among these uses Naming Service of CORBA.

3.2 DSM-CC mapping to MHEG-5 operation

First MHEG-5 application is began, service gateway of DSM-CC is activated, and is made name space inside of application object. This name space can be mapped DSM-CC directory, and a directory can be included other directory, file, and stream. If these objects are included in a application, DSM-CC directory service become to get the only object reference. Using these methods, MHEG-5 engine can access a various objects of server's application.

MHEG-5 object is identified by ObjectReference composed of GroupIdentifier and ObjectNumber. GroupIdentifier is mapped DSM-CC, and ObjectNumber gives unique value in their object. The ContentReference which reference actual content of Ingredient object is mapped the same method in ObjectReference.

As StreamEvent interface of DSM-CC can transfer private data using PrivateDataByte field, this field is mapped StreamEventData of StreamEvent to each other. Also, CounterPosition which is inner attribute of MHEG-5 Stream class is mapped NormalPlayTime of their stream to each other.

Table 2 defines the mapping between MHEG-5 actions and DSM-CC U-U primitives.

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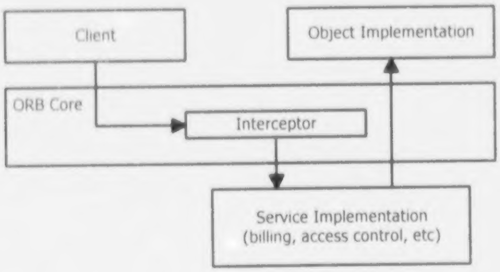
[Table 2] Mapping MHEG-5 actions to DSM-CC U-U primitives

Object type	MHEG-5 action	DSM-CC U-U primitive
Application	Launch	dsm.Directory.open() dsm.File.read()
Scene, etc.	Prepare	dsm.Directory.open() dsm.File.read()
Video, Audio	Run	dsm.Directory.open() dsm.Stream.play()
Stream	SetSpeed(0)	dsm.Stream.pause()
	SetSpeed(1)	dsm.Stream.resume()
	Stop	dsm.Stream.close()
	StreamTimer	dsm.Stream.getNormalPlayTime()

3.3 Additional Services

In this section, we'll discuss about extension of DSM-CC for additional multimedia service offering. If DSM-CC implements the general RPC, the extension of service or the distribution of different mechanism cannot considered. On the CORBA based implementation, it is able to use the existing defined CORBA service as previously stated service extension using interceptor who defines CORBA standard is easy. Figure 4 displays the service extension example using interceptor.



[Figure 4] Interceptor & service extension

Extensible service using these mode are billing service that is adaptable in service of video on demand, audio on demand, home shopping, and digital interactive TV, the user competence control function for the distributed multimedia framework, and can complete distribution of service using CORBA.

4. Implementation strategy

In this chapter, we suggest implementation example for proposed architecture. For various media resource, we use the web as infrastructure. We implement MHEG-5 client as Java applet, portable format of Internet application, and use CORBA as middleware for DSM-CC C/S environment. Figure 5 shows our implementation example architecture.

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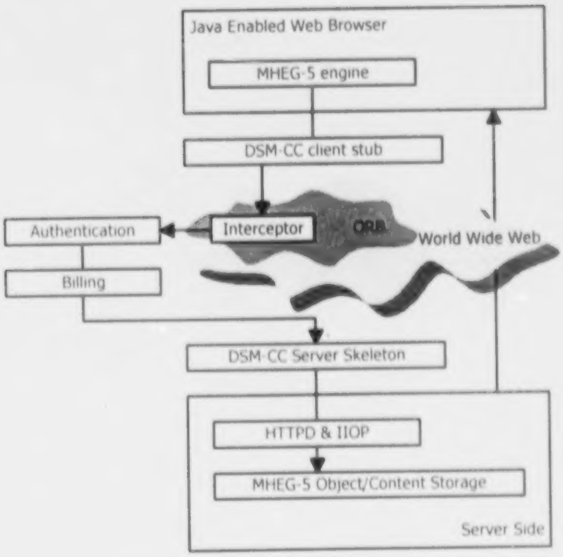
Java Enabled Web Browser
MHEG-5 engine
DSM-CC client stub
Authentication
Interceptor
ORB
World Wide Web
Billing
DSM-CC Server Skeleton
HTTPD & IIOP
MHEG-5 Object/Content Storage
Server Side

[Figure 5] Implementation example

In client side, using the web, end users easily access multimedia services. In addition, in server side, service providers can provide additional services via web, worldwide hypermedia environment, and huge amount of resources. We are currently implementing billing service, additional service component for video on demand.

5. Conclusion

In this paper, we proposed new architecture for MHEG based distributed multimedia system. It appears as an extension of DSM-CC, the digital media control protocol. It is based on OMG's CORBA, mapped into CORBA interfaces and MHEG-5 objects' behavior.

Proposed design has several advancements that are impossible in pure MHEG standard and current web. User and resource controls, real distribution of application servers and providing additional multimedia service facilities.

References

[ISO95] ISO/IEC IS 13522-1 *Information technology - Coding of Multimedia and Hypermedia information - Part 1: MHEG object representation - Base Notation (ASN.1)*, 1995.

[ISO97] ISO/IEC IS 13522-5 *Coding of Multimedia and Hypermedia Information - Part 5: Support for Base-Level Interactive Applications*, 1997.

[ISO98] ISO/IEC IS 13818-6 *Information technology - Generic coding of moving pictures and associated audio information - Part 6: Extensions for DSM-CC*, 1998

[OMG97] OMG, The Common Object Request Broker Architecture and Specification Revision 2.3, *OMG Document*, 1997

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Using Dynamic Page Construction to Reach Several Potential Audiences

Colin Chambers
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Abstract

Many factors have led to the wide spread use of content databases on the web. The provider feeds information to and from their content database(s) through a system which tailors the required content into formats suitable for display on the clients' machines.

This paper looks at designing information feeds for a different set of client needs. It is often the case that the basic information base held by a provider is of interest to disparate client populations. The technology which provides the format for content feeds also introduces graphic and interactive design into the display. The impact of the site depends on these elements, and makes a fundimental difference to how (and if) the information is recieved.

Two sites, one set of content

I am currently working on a site which 'speaks' to two separate audiences. Content held in one central location outputs two separate sites which have different purposes. One site delivers information to students on the courses within Staffordshire University. The University would like to tell people in the community about opportunities for returning to education and lifelong learning. Both these need course information, but will approach their selection of information in separate ways, and need a different level of description. The process of creating separate design structures for separate users is as crucial as getting the same designs to appear on different technological formats

Never Mind the Browser - Feel the Width

Darius Khadjenouri
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Abstract
In print design, desktop software has allowed designers to control the form of final publication. Type, content, imaging and pre-press are all part of one design process. By taking ownership of the entire medium of networked multimedia; from content to delivery, a designer can look developing in three broad areas. 1/ the backend server process; 2/ content organisation and interface design 3/ delivery in a browser. This panel presentation uses an example project - just completed - to highlight the need of a specific browser to deliver controlled content within an educational environment.

Designing to the medium

Our brief was to create a content generator (for staff) and delivery system (for students) that tracked student progress through a work experience module at Wolverhampton University, England. The content had to be editable (by staff); it had work from a central server to remote clients (within the University's student facilities); and it had to able to be installed on student local drives (at home and at their place of work). The software's design and functionality had to provide students with a consistent interface to the University and its corporate identity.

We based the system around a locally held database, as we could not guarantee access to the internet while on work placements, but we still built the students' interface using HTML protocol. So we created our own browser based on Microsoft's internet explorer. We then created a rich text to html converter to allow easy document creation for the editing of content (for staff) and entry of information (for students). Because of the browser integration, the completed project is now able to sit easily off-line or on-line, integrating activities into a unified environment on and off campus.

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Sleeping With The Enemy, Web Based Learning Without A Safety Net

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Abstract: The purpose of this panel is to look critically at distance/distributed learning courses that panel participants have/will taught/teach with an eye to making recommendations for correcting any "negative" fall-out. Web based courses are a dramatic change in the teaching/learning process and many educators and administrators jump in with only an eye to the "positive" and are dismayed when confronted with the "negatives."

All of the panel participates are enthusiastic proponents of Distance Education, with experience in televised distance learning as well as both synchronous and asynchronous Web based instruction. Every delivery system has it's plusses as well as minuses, and it is imperative that the appropriate system be used as well as an analysis of the target audience.

Statements from Panel Members:

Melissa Lee Price, Ph.D.

Research on the personality characteristics of successful distance learners has been conducted for over thirty years. Successful distance learners are generally more internally motivated and are usually non traditional in age. This research is exemplified by the success of programs such as Phoenix University, which focuses on working professionals eager to complete a Master's degree in business. As more and more universities offer courses at a distance, the number of traditional aged undergraduates taking them has increased. One of the issues that faces anyone teaching in higher education is motivating 18-22 year olds. This is difficult enough in a traditional classroom but what are the implications of a class of students needing external motivation taking a course that is appropriate to students who are internally motivated?

During the past five years, I've taught several courses in a Web based chat room. The first experience was with fifteen doctoral students enrolled on a Ed.D. course at a university in Louisiana. The students, however, resided in many different areas of the state, Texas, and even Canada. Twice a week in groups of six or seven the students logged into a synchronous chatroom to discuss weekly readings. As the summer progressed several academics at other universities 'dropped' into the chat room to participate in the discussion. These 'guests' had not been planned prior to the course beginning, but were a spontaneous result of my discussion of the teaching process with friends.

I quickly noticed that when there were 'guests' in the chatroom the conversation was much more vibrant. I utilised guest speakers in a more formal way the next time that I taught in a synchronous chatroom. This occasion was with an undergraduate class at a private college in New York state. The students were for the most part traditional aged and were all resident at the college. The course was designed to showcase the potential for distance learning for the administration. Again, it was very successful, with students giving high marks for the process of teaching/learning in a chatroom.

The next time this course was offered it was decided to split the delivery method to using both the synchronous Web based chatroom and an asynchronous environment, Lotus Learning Space (LLS). Several months were spend in locating material and building the LLS Courseroom. Again, students were assigned weekly readings to be discussed in the synchronous chatroom. I expected the experience to echo the previous years. Alas for high expectations. The semester got off to a rocky start with several of the students using the chat time to discuss where they would go to party that weekend. The harder I tried to pull them back on task the more they moved off topic. After a face to face meeting with the students to discuss appropriate behaviour we again met in the chatroom with somewhat better results. As the semester progressed, however, it was obvious that there were some disruptive students.

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On several occasions a student entered the chatroom under a fake name and proceeded to post pornography and to make off colour remarks. One student made a habit of asking the guests personal questions about their love lives. I ended up spending half the chat time trying to chase down the disruptive elements. At the end of the semester the student evaluations, which in the previous semesters had been very high, were much lower, with many of the students complaining about the disruptions.

So, how does an instructor handle students who aren't prepared for the distance learning experience? In a face to face class room one can always make a disruptive student leave the room. In Cyberspace, it's very easy for a student to hide behind an alias and bring the entire class to chaos. Unless the you have the software to boot them from the room, you're stuck with them.

Michael R. Ogden, Ph.D.

I will be discussing the "tentative" results of a comparison between last year's synchronous, web-supported, interactive TV graduate class and this Fall's totally web-delivered, asynchronous (with a few sync "tutorials" in WebCT Chat Room) "Distributed Learning" model of the same course.

If I might "pontificate" for a moment, I believe that the future of higher education is bifurcating into the more "elitist" residential programs that have prestige as a "pull" to fill the traditional classroom, and those institutions that are seeing their traditional revenue stream(s) drying up (for various political and/or economic reasons) and are needing to diversify their revenue streams (without incurring much additional cost) beyond traditional classroom delivery... Distance education used to be the big THING, but this required all involved to be "present" at the same time to participate (synchronous); interactive teleconferencing classrooms were built, networks developed, methods of keeping geographically removed students involved were employed... Well, as the world becomes increasingly more "networked" to the desktop and as "students" become less and less "traditional" in their educational needs/expectations, and as work/social pressures put more and more demands on our time, we are seeing the development of DISTRIBUTED EDUCATION, based on an asynchronous model; student driven, outcomes based, multi-modal in delivery (web, broadcast, email, correspondence, fax, phone, etc.)... All well and good, but "so what?"

The "so what" question is almost as hard for those of us who are distance/distributed ed. enamoured as the "what can go wrong" question... I received (via the Red Rock Eater Distribution List, 04/7/1999) the following question from Phil Agre which I think pertinent to what I'm trying to get us to examine.

> So my question is, what *can* go wrong with technology-based teaching, especially in large college classes? I'd love to hear any anecdotes, checklists, rants, speculations, concepts, references to the research literature, and so on, and especially the sorts of things that the [teachers] who are embracing this technology might not have thought about. What can go wrong educationally? politically? financially? administratively? technically? sociologically? psychologically? All of that. My own stance, as you know, is not that technology in teaching is inherently good or bad, but simply that one should take the entire context into account, articulate all of the values that are at stake, and make conscious decisions from the whole range of social and technical options.

I have been to many conferences were panellists talk at length about "their" system of distance/distributed delivery of education. Pretty "gee whiz" and positive in their presentation -- nobody talks of the down side... I agree with Phil (above) that we need to "contextualize" the discussion; to look realistically at the possible socio/cultural and politico/economic impact of such a significant, technology-induced, change to education and educational delivery (both positive & negative).

Brian L Griffiths, BA, MA, ATD

Many educators still perceive Synchronous-Asynchronous Digital Learning Environments (DLEs) to be 'easier', more efficient and more appropriate delivery vehicles for courses in the HE context. In fact many HE managers and administrators see this technology as 'THE' solution to the enormous pressures on institutions to do more and better with less.

As a DLE project leader and developer one of the most important issues is that of appropriateness and context of the 'course' or material that are delivered via DLEs. The School of Art & Design at Staffordshire University where I am based delivers a wide range of practice and theory based courses covering Fine Art, History of Art & Design in its many forms, Graphics, Glass, and 9 other design disciplines as well as Ceramics. These are delivered with varying levels of support from DLE elements - but are predominantly delivered in conventional, traditional mode in common modular framework. In this practice based curriculum, both learning and teaching say the practice of Glass (blowing or slumping) or Ceramics (throwing or casting) via a DLE is, I believe, less than realistic or possible with current and affordable technology resources - webcams are not appropriate! Such teaching and learning requires direct, real time support with dangerous and expensive capital equipment; total sensory feedback for the practitioner and for the supervisor; and must cope with texture, scale and colour fidelity.

In fact, beyond the utility of email communications and web-based information centres/bulletin boards/intranets this type of experiential learning probably should rarely be considered for DLE support.

However, Staffordshire University is located in the 'Potteries' where the original industrial revolution was nurtured, where there are world class and important collections of ceramics, where the HQs of many key industrial players (Wedgwood, Royal Doulton, Spode etc) are located and where there are internationally recognised HE courses such as the MA in Design for Ceramic Production and the MA in the History of Art and Design.

From this background the 'MA in the History of Ceramics', a predominantly visual and textual study is an 'ideal' and appropriate programme for bringing together existing experiments in DLEs for a genuinely international market/audience who wish to study at a distance asynchronously. The ceramics collections based in the region (private, public, commercial and at Staffordshire University) will be made available together with access to the University's growing resources in staff webpages (handbooks, information packs, study guides etc), Lotus LearningSpace resources (collaborative learning tools (the course room) and the computer aided management of learning) and COSE (a Staffordshire University developed DLE).

In addition, this flagship project, as for all DLE courses/programmes/awards, must have a very well defined structure and educational context - beyond a modular framework. This should encompass clear definitions of terms for all participants of such as independent learning, resource based learning, collaborative learning, a learning community, non-traditional assessment methods and assessment criteria etc. It must also include an extensive induction programme; a supervisor-student learning contract (to support independent learning and maximise the supervisor-learner contact [the tutorial clock]); differentiate learning between 'high-flyers' and those with (some) learning difficulties (say dyslexia); online help for those experiencing technology difficulties and with some social and physical interactions e.g. summer schools or study trips.

This context ensures the success of the course. As a DLE evangelist it is my belief that without this such projects/environments will be prone to both random failure and success, making evaluation of the REAL opportunities difficult if not meaningless.

Marie Lewis, BA (Hon)

Over the last two years I have been involved in the development and teaching of web based modules via a Digital Learning Environment (DLE). The evaluation of this new mode of delivery is currently under review, however, the perceived benefits and persistent trend towards DLE's promises an unlikely return to the traditional mode of delivery for these modules.

There is a growing pressure at Staffordshire University, as with many other institutions of higher learning, to deliver and assess students using a DLE. While it is pertinent to say that some modules would seem particularly suited to this mode of delivery, the effectiveness in terms of teaching and learning is by no means assured. Do the benefits outweigh the extensive efforts required to develop effective DLE's? In order to answer this question we require feedback from students, developers, tutors and technicians alike.

To assist in assessing the effectiveness of using a DLE to deliver the said modules, students were required to complete a questionnaire. I am currently reviewing the resulting feedback and comments, and additionally, numbers enrolling onto follow-up modules in order to assess student satisfaction. It has, however, been noted that although a student may appear to enjoy a module, a good pass grade is not guaranteed. It is important therefore to correlate assessment grades with the student questionnaire feedback in order to gain a genuine overall picture.

Ideally we need to look at the outcomes of the same module being delivered using both traditional and DLE modes. We cannot, however, rely on such information being 100% accurate, as some successes/failures would be attributed directly to the students preferred mode of learning. I hope, however, that the data collected will provide a fair indication of how effective, from a student perspective this new mode of delivery has been.

Another major attribute to the success of courses delivered using DLE would be the structural quality and usability of the system as a teaching, learning and assessment package. Educational consistency is a major benefit of CBT, but the danger is that we may be consistently using poorly designed and implemented systems. Student resistance is most often attributed to the prior level of computer literacy but it is also extensively connected to the quality of the learning package.

Included in this evaluation will be responses from staff involved in the development and tutoring of such DLE modules.

Freedom of Expression in the Cyber-Frontier

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Abstract: This panel examines the current and future Internet as a world-wide marketplace of ideas and of commercial goods and services. It investigates the motivations for regulating the maintenance of free electronic communications and trade, identifies current and future technologies and other (primarily legal) mechanisms for maintaining control over them, analyzes current national and international attempts to regulate them, and proposes an international solution for minimizing interference with the operations while addressing the major objections against a minimally-restrictive oversight. This topic is important to all who need and deserve a minimally-regulated Internet, because the Internet is a marketplace of ideas and information as well as a marketplace of goods and services. Furthermore, the Internet is a medium for self-expression and self-fulfillment. While some regulation of this medium is essential, proposals to minimize this regulation are in the best interests of all who access the Internet.

1. Position of Brian C. Snow

The Internet is a superior technical medium for popular communication, because it transcends national borders. Wired communication does not respect borders, except where communication is artificially constrained by government regulation. Anticipated developments in wireless Internet delivery further minimize the mechanisms available to control content. The Internet provides for two-way and multi-way communication as well as synchronous and asynchronous communication modes. It provides for the creation of true multimedia documents through the use of audio, video, text, and interactivity providing for a richer communication experience among users. The Internet also provides for anonymity, breaking down barriers and the fear of reprisal against unpopular or controversial beliefs, opinions and ideas.

Governments around the world seek to regulate the Internet because they fear the maximization of public access to ideas and information. Ideas are the foundation of self-governance; information provides the means of self-governance and many countries fear self-governance. Countries such as China are afraid of the possible social consequences associated with the unrestricted free flow of ideas and information. Many governments including the United States fear that the free flow of information across the Internet may compromise national security. Commerce on the Internet is also a concern of many governments because of the access to goods and services that were once available only on the black market in some countries. As with information, the influx of new goods and services may result in new and unforeseen social consequences. Another concern is that taxes, quotas, tariffs and other restraints may be evaded.

Countries have to face the reality that the Internet is not a passing phase, but a new medium that is growing at a pace never before seen in a medium. To deal with this, governments have reacted with knee jerk responses to silence or at least lessen the potential and often overblown impact of the Internet on society. Consumers are restricted access to information through a variety of devices and controls such as filtering and screening devices, tracing devices, interception technologies, exorbitant charges for Internet service, confinement of Internet access to select populations, and in some countries requiring Internet users to register with the state. There are moves to place more controls on Internet service providers (ISP's) requiring the use of screening devices, providing site ratings, required disclosure of users of selected sites, direct licensing or registration of ISP's, cryptography controls, holding ISP's responsible for conveying outlawed information, and direct penalties that include search and seizure of computers. Some governments have gone so far as to restrict access to the Internet to a state controlled gateways, and are placing restriction on access to government information.

Governments are also creating Web sites (e.g. Indonesia) that actually promote the idea of free speech, creating Webs sites that refute or confirm information or ideology available on other Web sites. Hotlines are also being created that provide avenues for complaints against Internet sites and for investigating such complaints.

Future technological developments threaten to circumvent most of the currently-effective controls on the Internet. These developments include the introduction of wireless internet delivery services, including personal communication services (PCS) and two way satellite communication services. Most of the current restrictions focus on land based not ether based connections. With the computer becoming even more portable it will become more difficult to track people getting on and off the Internet, especially when connecting through ether based systems. As more corporations, schools, libraries, governmental agencies become wired it will become increasingly difficult if not impossible to track people and what they are doing and saying on the Internet. In those countries that require a permit to access the Internet a black market is sure to emerge with unrestricted access permits going to the highest bidder.

2. Position of Dr. Warren Sandmann and Dr. Daniel Cronn-Mills

The Internet has opened a new realm of communication practices, allowing instantaneous communication regardless of geographic location, so long as one has access to the medium. People are able to both produce and criticize communication--again, as long as they have access to the medium. This new freedom of communication has been perceived as a threat, both by countries and nationalities wishing to control access to information, and by corporate entities fearing a loss of control (profits) over content which can easily be digitized. Music, books, images--all are forms of information which can easily be transmitted through cyberspace.

Given this state of affairs, national and international governmental bodies, at the prompting of both local political leaders and corporate executives, have begun discussion concerning the regulation of computer-mediated communication. In this paper, we will focus on three issues concerning international regulation of the Internet. First, how does the concept of national sovereignty play in the attempt to create international regulations? Second, what role would (or should) multinational and national "owners" of information play in the possible creation of international regulations? Finally, what effect would national legislation play in the possible creation of international regulations? Here we will discuss two U.S. attempts at regulation of the Internet, the CDA and the COPA.

Position of Dr. Richard Parker

The international solution for a minimally-regulated Internet relies upon the creation of international covenants of cooperation among nations desiring to regulate the Internet for specific purposes: (1) regulating child pornography and pedophilia; (2) regulating hate speech; (3) preventing the disclosure of identities of intelligence agents, law enforcement officers, etc.; (4) regulating threatening speech; (5) preventing the disclosure of the content of ongoing legal proceedings; (6) regulating the publication of libels; (7) preventing the disclosure of national-security information; (8) enforcing a ban on sales of prohibited products, such as prescription medicines, weapons, illegal substances, etc.; (9) enforcing bans upon specific services, such as prostitution, gambling, slavery, or prohibited medical practices.

The proposed covenants would require participating nations to cooperate in several ways. First, the nations would need to agree upon a definition of the prohibited idea, content, product or service. Second, the nations would need to maintain free hotlines for telephone and e-mail reports of sites in violation of the covenant. Third, the governments of participating nations would agree to report the existence of sites that violate the covenant to the nation of origin. Fourth, these governments would agree to initiate investigation and prosecution of website and home page creators under existing laws, and to institute operational shutdowns as necessary, where reports of violations warrant action within their borders or jurisdictions. However, national rules of criminal and civil procedure would remain in force, the civil rights of individuals charged under the laws would be protected to the extent such protections are currently provided, and the national sovereignty of participating nations would be insured. Fifth, the governments of participating nations would agree to report the outcomes of investigations and prosecutions to the originating nation.

The proposed covenants would contain two additional provisions designed to minimize regulatory interference with expression on the Internet. First, participating nations would remain free to create or subsidize government or government-promoted websites that provide "correct" information and/or rebut "incorrect" information provided on non-governmental websites. Second (and most controversially), participating nations would agree to place no additional restrictions on Internet content, such as those identified in Dr. Snow's position paper, for the purpose of regulating the prohibited idea, content, product or service. This would mean that participating countries would agree to eschew national regulations, such as those discussed by Dr. Sandmann and Dr. Cronn-Mills, in favor of the more tolerant Dutch approach emphasizing minimal regulation.

The proposed system of international covenants is likely to work, for several reasons. First, it sanctions existing controls upon materials that nations mutually agree to regulate, rather than asking participating countries to reduce existing regulations. Second, it guarantees a cost-efficient mechanism for reporting violations by using toll-free telephone numbers or government-maintained websites. Third, it provides for international pressures upon a nation to comply with the terms of the covenant. For example, the United States would cooperate with the Netherlands in taking legal action against an offending website originating in the U.S. not only because both nations signed the covenant, but also because the U.S. action would provide a bargaining chip to convince the Netherlands to take legal action against Dutch offenders. Fourth, the covenants obviate the need for additional controls upon Internet content, ISPs, consumers, etc. Enforcement of the covenant would strike directly at the origin of the problem—the offending website. Fifth, the system of covenants ensures a minimally-restrictive regulatory system for the Internet because it constitutes an agreement among signatory countries to use the hotline system rather than more restrictive means. This frees ISPs, consumers, libraries, schools, cyber-cafes, etc., from imposing cumbersome and oppressive regulatory measures in order to comply with government regulations.

Poster/ Demonstration Papers

The Earth is a Book: Using Hypermedia to Teach Archeology

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The motivation for this work was the construction of the hydroelectric plant "Serra da Mesa" in the state of Goiás (middle west of Brazil). To minimize ecological impact, the Brazilian government requires that an "Archeological Salvage" program to be executed in the area to be salved.

In the beginning, the purpose of this work was to help the museum by building a data base and processing information about the pieces collected in the field.

The development of the project, however created a rich environment involving researchers from several areas such as cartography, geography, biology, anthropology, chemistry, sociology, physics, journalism, etc. That environment was the trigger to expand the project from a simple database development to the proposal of a project to develop hypermedia based teaching material (or a system) using the multidisciplinary knowledge available.

The project was incorporated into the Metropolitan High Speed Network program sponsored by the federal government. The project was decided to target teachers and students of public high schools which are being equipped with high speed network and multimedia computers.

The main guidelines of the project can be summarized as follows:

1. *Communication with specialists*: asynchronous communication using e-mail.
2. *Discussions groups*: moderated by museum's staff, discussions on specific subjects are encouraged among students and specialists.
3. *Chats*: the environment should allow users to take parts in chats with specialists and also with students;
4. *Videoconference*: although a high speed network is available, the costs of the stations should be kept low. It was decide to use the video conference software CuSeeMe;
5. *Assessment*: instructors should be capable to assess students development;
6. *Fun*: the environment should be fun to be used;
7. *Multimedia*: actual films, photos and location of objects of archeological sites should be available,
8. *Access to museum's database*: although this feature is not directly related to learning, it was decided to allow users to query the museum database;
9. *Virtual reality*: although it was decided that immersive virtual reality (based on the use of helmets) should not be used.

Acknowledgements

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Knowledge Net:
A Web-enabled Information Service For Continuing Education

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The National Defense University *Knowledge-Net* is a web-enabled service of the Information Resources Management (IRM) College. It is seen as an alternative Information Age strategy for the university to deliver just-in-time continuing education to its graduates and provide a vehicle for life-long learning. The first channel under development is intended for Chief Information Officer staff. It provides the following frequently updated services for each of ten CIO competencies:

FAQ: Questions and Answers concerning fundamental concepts
NEWS: Summary of recent developments related to the competency
ISSUES: Current and emerging issues, options being considered, and their implications
CASES: Best practices in real-world applications of the competency
EVENTS: A listing and links to conferences, training, and educational programs grouped by the competencies
RESOURCES: Annotated links to other web reference sources grouped by the competencies
DISCUSS: An asynchronous threaded conferencing service for discussion of topical issues
CHAT: Scheduled real-time chats on particular topical issues

Thyroid and WWW

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The eradication of thyroid disease was declared a priority by the World Health Organization. One of the obstacles of this fight is the lack of a unified approach to the problem. Local territorial conditions influence the prophylaxis and treatment of patients in a particular region. This situation can only be dealt with if a wide access to modern scientific data, exchange of information, and education of specialists of all levels is provided worldwide. Formation of an international network dedicated to thyroid disease may be the first step in this direction.

At the present time under the guidance of the Informatics Department of the Yaroslavl State Medical Academy, efforts of specialists from many fields including physicians, programmers, and scientists have lead to creation of a new website about thyroid disease (http://gw.yma.ac.ru/~thyrpath/index.html). This website covers most of the aspects of thyroid disease in the Yaroslavl region of Russia, where this condition is endemic.

Main topics of this website are:
1. Ecologic aspects of thyroid disease,
2. Prophylaxis of thyroid disease,
3. Newest developments in the diagnosis and treatment of thyroid disease,
4. Electronic library on thyroid disease available to students,
5. Information for patients.

Dialogue Programming for WWW-based Systems

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Abstract: This work describes the approach of classification, specification, description, and automatic generation of dialogues in WWW-based systems. Using Design/CPN and Coloured Petri Nets, common applications and their dialogues are formally analysed and several basic dialogue elements and their structures are deduced. The basic idea is the separation of the structure of a dialogue from its style. This separation enables the description of dialogue systems without spending too much effort on the presentation. It is possible to change the presentation of a dialogue by using different style files. Furthermore the system can change the style of a dialogue, depending on the user who is working with it. Our set of dialogue elements, called S-Dialogues, is forming this fundament of general dialogue systems. The system itself can be described by using an extension to Latex, called Latex-ES, where additional tags and style files are provided to the application designer.

The Savvy Cyber Teacher™: A Professional Development Series Integrating Internet into the Curriculum

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Promoting four unique and compelling applications of the Internet in the classroom — real-time data, unique resources, global collaboration, and web publishing — in a hands-on course with ongoing on-line support not only reinforces national content standards for K-12 teachers, but also nurtures enlivened classroom instruction and student engagement in authentic tasks.

A Technology Innovation Challenge Grant from the U.S. Department of Education supports this turnkey training program for professional development, in which trained master teachers become instructors within their schools and districts. Miami, Phoenix, and Cleveland schools collaborate with career centers, higher education and research groups in this unique partnership. Workshop materials include comprehensive, detailed trainer and participant guides, web projects and data to improve and deepen student understanding of concepts, lesson activities, and online support tools. In ten 3-hour sessions, teachers not only master technical and pedagogical skills necessary for effective Internet integration, but more importantly, concepts and resources for engaging students in authentic tasks, critical thinking and problem-solving.

A Simple Organizational Social Structure Which Enables Technology to Infiltrate the Faculty and the Curriculum.

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Ensuring that technology infiltrates the learning experiences of students at all levels is often the task of the politically naïve on-site CIO techno-guru. While there is no doubt in most peoples minds that technology is relevant, even crucial to the finished product – the educated student, the actual embedding of the technology in the curriculum and more especially in the lives of the faculty is a social, not a technical process. The CIO would be well served by the formation of a "technology council" which meets regularly, presided over by the CEO and staffed by representatives of all of the big budget departments on site. The CIO takes the position as the secretary to the council, regularly demonstrating potential applications and generally provoking the departments to compete for credibility in the meeting with their own implementations. Outside the meeting, creative ideas are presented to departments individually by the CIO who assists in making them happen.

Theoretical Foundations of Computer Supported Sustainable Learning Processes (CSSLP)

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Abstract: This paper introduces the concept of computer supported sustainable learning processes (CSSLP) and presents a theoretical framework of the research area. Key aspects are discussed in relation to relevant terms and issues such as, learning processes, collaborative learning, distance education, distance learning, situated cognition, and situated learning. The main focus of the paper is to clarify the terminology introduced and used in our research about CSSLP. Constructivism and Papert's constructionism is discussed as well as Resnick's Distributed constructionism.

Normally the learning process, in educational settings is based on activities such as lectures, seminars, tutorials and practical work. From our point of departure the learning process differ a lot, and it is essential that within the research area of CSSLP different learning-processes and attached activities are elaborated and evaluated. The paper describes some fruitful approaches in this process.

Use of Video analysis to Enhance Faculty Teaching Performance

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Abstract: Although it has been possible to videotape teachers in their classrooms for a number of years methods for analyzing the contents of the tapes are not fully developed. The use of formative, reflective evaluation of teaching is not commonplace among university faculty. The thoughtful development of video analyses and its corresponding reflective tools is important for faculty as teaching becomes a more important focus for faculty advancement. The instruments used here are being piloted at the University of Texas at El Paso (UTEP) and used for faculty self reflection.

Students and Computers; Ability, Availability and Attitudes

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Before introducing computer based distributed learning into its nursing curriculum the Institute of Health and Community Studies conducted some research into students' computer ownership, use and attitudes (n108)

Computer ownership amongst students prior to starting the course was 64%, however nearly a fifth (18%) used computers less than monthly, and over a quarter had never searched the WWW. Less than half (43%) responded positively to the statement 'I like working with computers' and around one quarter (24%) only use a computer if they have no choice.

The attitude of students to being asked to use IT was encouraging, with almost half looking forward to using it, but there was a significant minority who did not relish this requirement. The results suggested that students would need quite a lot of support if they were going to successfully cope with the IT requirements of the course, and a support programme has been implemented ahead of the introduction of online materials.

Holistic Approach for the Use of Multi Media and Multi Modality: Digital Storytelling

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The components of humanlike conversation are ought to be connected by a dramaturgical context. This dramaturgy approach used in multi media, multi modality and programming logic is a main aspect of Digital Storytelling. Digital Storytelling principles are to be transferred to the following tools and methods:

- Programming language for designing holistic applications.
- Methods to evolve the way of thinking of authors.
- Methods to encourage an intuitive designing.
- Designing methods to evolve the power of expression of multi media applications.

First results are a avatar system for conversational interaction in virtual worlds as well as a audio and video systems, including dynamic hyperlinks in combination with speech recognition.

At-Risk in Cyberspace:
Enhancing Engagement of High Risk Students in Internet-Based Courses

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Abstract: Concern has grown about the utility of technology based education for at-risk learners. This study explored effects of enhanced motivational and relationship building communications on at-risk students' engagement in an internet-based multimedia course. Patterns of engagement and moderate to strong effect sizes point to the need to systematically incorporate motivating dimensions into teacher-student communication.

Making the WWW Accessible - Just DO-IT

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Abstract: Technology has served to level the playing field for some individuals in under-served populations, opening doors to success that were not there in the recent past. For example, a few years ago electronic mail and gopher information servers provided individuals who were blind, using computers equipped with voice output, access to people and printed resources. For the first time printed publications became available to this group at the same time it was offered to others. Similarly, individuals who were deaf could communicate with others "privately" and efficiently, without the need for lip reading or sign language. As graphical images and audio clips become more widespread, will individuals with certain types of disabilities be the information have-nots once again? Stop by this poster session to obtain information about legal requirements, resources, and guidelines for making your Internet resources accessible to individuals with disabilities.

User Interface Guidelines for I*net Applications

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Abstract: During the last years the user interface has played a growing role in the applications' development, and often, especially in small enterprises, the analysis is restricted to the GUI drawing. This practice, which is basically wrong, may cause serious problems when it is used for the development of Intranet applications. The GUI's impact on these kind of applications is deep, involving the system architecture [Frontini & Morandotti, 1999]. A well written GUI should give high functions to heterogeneous users, using a subset of HTML and JavaScript to be cross-browser. The most relevant aspect of HTML-based interface is his ability to reproduce the same operations known by the user, requiring no technical knowledge about the GUI itself, therefore the user can keep his experience on the work to do and forgot any technical problem. We define such an interface "transparent". In this poster we explicate some guidelines to create transparent interfaces.

References:

Frontini, D. & Morandotti, P. (1999). L'Impatto Dell'Interfaccia Utente Nelle Applicazioni Intranet. *HCItaly99*, CNUCE and Consiglio Nazionale delle Ricerche, Rome, 1999. URL: http://home.intrasoft.it/RS/papers/GUIIntranet.html

BEST COPY AVAILABLE

Web-Based Support for Educator Staff Development

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Teacher training enhanced with Web pages can give teachers continual just-in-time support. While most teachers are experienced Web consumers, some lack experience using the Web. The opportunity to grow in Web experience adds value to training workshops. Workshop Web pages fill a continuum from full Web-based distance learning delivery to companion materials for a traditional class. The Web pages serve a multitude of purposes before, during and after the workshop. Before the workshop group meets formally, participants can read the Web page to become oriented to the topic of the workshop. During the workshop, the Web pages become a multimedia, interactive agenda where participants can return after the workshop concludes. After the conclusion of the workshop, participants have access to all materials and their additions and updates. For added functionality, and for teachers in schools still lacking Internet connectivity, the contents of the Web pages can be distributed on CD-ROM.

Remote Measurement System Using Internet

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Abstract: A vehicle for a complete engineering and scientists practical formation is presented. It is made possible by the use of virtual instrumentation, not in the sense of a simulation tool, but as the remote access to facilities located in related research laboratories. Internet World Wide Web provides a best way to materialize this remote access, reducing the requirements in the educational laboratory to workstations (WS) or personal computers (PC). The different parts that integrate the whole remote access measurement system are: the measurement instrument, a controller equipment that will be called instrumentation server, a web server and the client computer (PC or WS) from which the user accedes to the system. The user application has been developed in Java, in order to provide it a multiplatform characteristic. It contains the graphic interface, reproducing the front panel of the measurement instrument, by mean of which the user performs the set of remote measures.

The Role of Hypervideo in Learning Environments

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Abstract: The educational potential of the motion picture was early recognized by many, but technological and use constraints have limited, or perhaps just postponed, the fulfilment of this vision. Significant technological advances and the new tendencies for media convergence and integration are transforming video into a dominant medium, suggesting new ways to support learning activities. The purpose of this presentation is to contribute to the understanding of the effective use of video in education, in particular by discussing the role of hypervideo in learning environments.

Our approach is based on human cognition concepts, the way media relates to learning, and hypervideo characteristics. Video and television are usually watched in an experiential mode. Effective reflection requires some structure and organisation. Hypervideo provides the mechanisms to structure and navigate video, and to integrate it with other media. Its ability to integrate video as an active resource has immense possibilities. However, there are still some technical and methodological challenges. Technology will provide the tools; methodologies will guide the design for its effective use.

References

[Chambel 98a] Chambel,T., Bidarra de Almeida, J., and Guimarães, N. (1998). *Multimedia Artifacts That Help Us Learn: Perspectives of the UNIBASE Project on Distance Learning*. Workshop on Multimedia and Educational Practice, ACM Multimedia'98, Bristol, UK.

[Chambel 98b] Chambel,T., Correia,N., and Guimarães,N. (1998). *Time for Hypervideo on the Web*. WebNet' 98 - World Conference on the WWW, Internet, & Intranet, AACE Conferences, Association for the Advancement of Computing in Education, Orlando, Florida, USA.

[Eco 93] Eco, U.(1993). *Can Television Teach?*, Screen Education, no.31, Summer 1979. Also as Alvarado,M., Buscombe,E., Collins,R.(eds.), *The Screen Education Reader: Cinema, Television, Culture*. The MacMillan Press Ltd, pp.95-107.

[Norman 93] Norman, D. (1993). *Things That Make Us Smart*. Addison Wesley Publishing Company.

[Sumner 98] Sumner,T., Taylor,J. (1998). *New Media, New Practices: Experiences in Open Learning Course Design*. In Proceedings of CHI'98, Los Angeles, CA, USA, pp.432-439.

A System for Detailed Student Profiling

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Abstract

This poster demonstrates a system to track an individual student's performance in core criteria across a wide range of Art and Design modules. The BA(hons) Design Degree at Staffordshire University envelops glass design to media production; but the underlying ethos of the Degree is that all courses share common skills and knowledge.

In 1998 the School of Art and Design set up common intellectual criteria for all student learning; to be used to assess students at all levels on all modules. The shared criteria give the School an important tool. They can be used by faculty and students to understand an individual's progress and tailor the way that individual studies.

To make use of this opportunity, the School needs a system for capturing and collating individual grade for each criteria in each module. This poster show work results and work in progress towards this seemingly simple aim.

Interface Repository Viewer for CORBA

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Abstract: The Common Object Request Broker Architecture (CORBA) is structured to allow integration of a wide variety of object systems. It is convenient to serve a request thought an Object Request Broker(ORB). All request objects, which are correlative, are encapsulated. Interface is a description of a set of these request objects. A service provider can provide a service and register his Interface to Interface Repository. In other word, a client can query the Interface Repository and get the information of an interface which is provided in the environment.

We present a CORBA client application for programmers to query interface definitions. It is named Interface Repository Viewer(IRV). A programmer can get information from the Interface Repository by the graphical user interface of the IRV easily, like the file manager in Microsoft Windows. Besides, the contents of any object nodes can be directly retrieved and the detail information is showed in HTML form.

Reading Chinese Together: Uses of the Web Forum for Individualized and Group-based Language Learning

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Jung Ying Lu-Chen, National Foreign Language Resource Center, Univ. of Hawaii, USA
Stephen Fleming, National Foreign Language Resource Center, Univ. of Hawaii, USA

Abstract: This session tackles issues in teaching foreign languages on the Web. The poster presentation on course design for a Web-based third-year level Chinese reading class will address the following challenges:

- creating a model for Web-based course design that will be useful to educators without advanced programming resources
- designing strategies for use of the forum, or bulletin board, as a locus for several kinds of language-learning tasks
- coordinating hardware and software so that students working with various system configurations can all communicate in written Chinese
- selecting a combination of Web-based tools that suits our needs
- making use of students' background knowledge of the real world and of the target language as a jumping-off point for each lesson
- structuring lessons to conform to natural reading behaviors
- providing a combination of group-based activities and individual, off-line activities with opportunities for reflection and reaction

iPROXY: A Programmable Proxy Server

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Abstract: The main functions provided by traditional proxy servers are storing and forwarding web pages. In upstream, a proxy accepts browsers' HTTP calls and forwards them to Web Servers. In downstream, it caches data from Web servers and forwards it to original callers. iPROXY is an active, intelligent and programmable proxy server that performs additional computations for new services on HTTP calls and/or Web data during the storing and forwarding process. Computations are in fact performed by individual agents, implemented as CGI-bin on iPROXY and executed based on requested URL's. Furthermore, iPROXY provides a common platform for programming agents and a generic mechanism for hosting, integrating and executing agents. To demo its functionality, we have introduced new services in iPROXY, including TCP Tunneling, Chinese URL, Home Page Walking, Pre-Fetching, Archiving Services, and Personal Portal, without changing standard protocols like HTTP, DNS, or HTML, nor modifying existing components such as servers and browsers.

Using Student Experts as Technology Assistants in Schools: An Untapped Resource

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Abstract: One of the best resources for helping teachers implement their technology curriculum is a student tech assistant. In Woodridge School District a select cadre of students from each school is given formal training in advanced topics such as creating web pages, hypermedia, and network trouble shooting in order to assist the classroom teachers.

Teacher Training and Support of the Technology Curriculum: What to Do After the Network is Unpacked and Connected

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As school districts grapple with the related problems involved in implementing their technology curriculum, the biggest problem (after the funding battle is won) is training. The familiar refrain is: Now that we have the necessary funding for our technology hardware and software, how do we jump-start the new curriculum? Getting the network infrastructure in place and connected to the internet is only half the battle. Hiring a technology coordinator may keep the network "up and running" but it will not guarantee curriculum integration of technology into classrooms, which are understandably often under the leadership of a techno-phobic teacher who needs immediate, intensive training and support. There is a clear-cut need to discuss this aspect of technology education among people who have successfully implemented creative strategies, and people who would like to benefit from the experiences of others. A special interest group should be available for sharing training and support solutions. Our school district would like to share two of these solutions which have helped our teaching staff immensely. Two critical approaches should be used in training and support. First, use teachers as trainers who already exhibit an interest and aptitude in technology. Such teachers are perfect mentors because of their enthusiasm for technology. Concentrate further training on these teachers first. Then utilize them as trainers of the remaining staff. Role models are just as important as skill training during the crucial birth period of your technology curriculum. The second urgent strategy is providing teachers with expert support service "at their elbow" as they launch their technology curriculum. Accomplishing this may be simpler and less expensive than imagined. One of the best ways to help teachers implement their technology curriculum may surprise many educators who overlook a nearby, untapped, inexpensive resource - their own students! The reason for this blindspot is that educators naturally view students as the consumers of the educational process rather than as part of the team of producers. In Woodridge School District located in suburban Chicago, a select few students from each school who demonstrate "high tech" aptitude are given formal, advanced technology training in special summer school classes. The advanced topics they learn are not those found in the normal technology curriculum. They include how to create web pages, hypermedia and trouble shooting.

The "Virtual Classroom": Perspectives From Educators And Students On Computer-Supported Instruction In Higher Education

Jo Ann Coe, Nancy Brown, Miriam Johnson, University of South Carolina, USA

This poster/demonstration system will present a project that utilized a course management software system (Intrakal) for developing on-line materials for graduate social work courses. The authors discuss their experience in relation to teaching and learning as well as present the evaluation results of students' experiences with the course management software system.

Multi-Dimensional Web-Based Learning in Freshman Chemistry

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Abstract: The dimensionality referred to in the title is the many different learning styles of students. The presentation gives information related to a study of how to incorporate the many different learning styles of students into a web-based course in chemistry. We tried to develop a site that accommodates visual, verbal, sensory or intuitive, inductive and deductive, reflective, linear or non-linear, and many other types of learners. Some degree of socialization was developed with components of WebCT and the use of office hours with NetMeeting. The site is still being developed as other topics such as continual assessment and multiple feedback are being incorporated. The site is at http://stern.kennesaw.edu/~lcombs/GenChem1, but some components of it are password protected. An on-line text also incorporates video (Real streaming) in short segments (<10 minutes) presented on various topics encountered in the first semester of general chemistry.

New Realities, New Rhythms, other Structures

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Abstract

It is important to analyze the role of screens – computers specially – in the image era we are living, the development of computers as new characters in our every day lives and the intimate relationship established between the user and the multimedia background in front of him.

E-mail, internet, animation programs, image processing and other social-artistic advantages of the computer bring other alternative means of self and world perception. New concepts of time, space, thinking, feeling and sensing permit the user a self identification with a medium that doesn't judge, that will let him express freely and will permit "reality" manipulation according to the new interactive person´s interests.

We like to DO by ourselves, to modify, to propose; we enjoy expressing ourselves in writing, we love contacting the outside world in a matter of seconds, we like having varied information available via images… All this is offered by new communication technology systems represented and presented on the computer screen (our matte).

References

Piscitelli, A. (1997) *Ciberculturas. En la era de las máquinas inteligentes.* México: Paidós.

Lorite, N. (1997) *Investigar las transformaciones sociomediáticas.* España: Valparaíso University Seminar.

Web-based Learning for Practicing Health Professionals- Does it Work?

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During the Fall of 1998 an information management strategic planning group in the IWK Grace Health Centre identified five key directions for information management in the organization. One of these directions outlined the use of innovative learning technology to support learning for health centre staff, patients and families and partners. In response to this direction a working group conducted a pilot study in which a learning opportunity was offered to multidisciplinary health professionals using a web-based learning environment. The learning opportunity was a certification program which had been traditionally offered using a paper-based self-learning package. Two groups participated in the study, one group had previously completed the paper-based version, the second group was experiencing the content for the first time. This presentation will include a description of the pilot study and demonstrate the key features of the web-based learning environment. Results of the pilot study will also be presented with suggestions for future web-based learning applications in a health care environment

Participative Evaluation of Collaboration Projects of Computers in Education

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The integration of computer as an educational innovation implies to become completely submerged in researching as a way of appropriation of knowledge, narrow the distance between theory and practice, acquisition of solid theory basis as a reference point to analyze practices and also for the construction of autonomy using the scientific education.

We live the time of creation, of restauration of singular elements, of the appearance of new potentials.

Through this perspective, the CIEPUCRS - Brasil" proposes the accomplishment of participative evaluation of collaboration projects which may qualify teachers for the re-invention of pedagogical techniques and for critical utilization of technological resources, that alone demands improvement and personal appropriation of the role as a professional, enabling a collective re-invention in an interdisciplinary way.

The Functional Web: User Testing Your Site

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Abstract: We recently put our content-rich information technology site to the test by sending members of our campus community on a "scavenger hunt" for some of our most frequently requested Web-based information. By observing their actions, we discovered first-hand dozens of usability problems concerning content organization, navigation, naming conventions and more. The good news was that our two testing cycles led to many improvements that were both easy to make and resulted in faster and more intuitive information retrieval for our users. This poster session will highlight our testing process and results. I can also answer questions about how we planned for and evaluated low-cost observation-based testing and how we're continuing to build this important activity into ongoing Web projects.

How and Why Faculty Are Incorporating WebBased Technologies into Teaching Practices

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This study's purpose was to identify how selected university faculty members are integrating instructional technology into their teaching practices and to determine the primary intrinsic and extrinsic rewards and incentives that influenced them to do so. Data were gathered using a survey instrument and interviews. Email was reported as being used more than any other computer-driven instructional technology followed by using web-based materials that support course content; showing computer-projected visuals while lecturing; and, providing a web-based syllabus. Faculty members were overwhelmingly influenced to start using instructional technologies by intrinsic rewards and incentives, primarily because they wanted to increase their teaching effectiveness and improve their instruction. The most influential extrinsic rewards and incentives were related to receiving work-related support and recognition. It can be concluded from this study's findings that instructional technology will be adopted by faculty who want to improve their instruction and perceive technology use as beneficial to students.

Web Resource Collaboration Center: Providing an Integrated Tool to Support Lifelong Learning

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Influenced by generative and intentional learning methodologies, the Web Resource Collaboration Center (WRCC) was developed to provide a structure and forum for lifelong learning activities by empowering learners to build their own Web-based knowledge bases and support systems. The WRCC – written entirely in Perl – enables learners to collaboratively build comprehensive knowledge base systems that use the Web to provide on-demand access to integrated information, guidance, training, and tools that support learning and performance.

To provide a structure for these activities, the WRCC is broken into three functional areas: Discussion Forum, Link Manager, and Resource Construction System. Using the Discussion Forum, learners can communicate and work together on ideas and challenges. Learners use the Link Manager to categorize and critique resources found on the Web. The Resource Construction System is a learner-centered collaboration tool for developing unique resources for inclusion in the WRCC's Link Manager.
For an example, please see http://www.cudenver.edu/~jdunlap/wrcc/example

ON-LINE LEARNING WORLDS FOR COMPUTER APPLICATIONS INSTRUCTION

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Abstract: The pace at which high speed, high powered computers are being produced mandates a new mindset from those empowered to produce the manpower for the next millennium. The past decade has quickly produced the majority of job opportunities that specify "computer experience required" for both business and industry, and educational environments. Purdue University and Ivy Tech State College - Lafayette recognize that on-going computer instruction is a viable solution to some of the instructional goals defined as a result of manpower needs in our society. As such, this poster/demonstration presents the preliminary works of this collaborative effort to develop on-line learning worlds for teaching computer application skills that have the potential to increase learning, recall, retention, and ultimately transfer into both workplaces. Included in the demonstration will be preliminary data and analysis of student performance, overall learning, and comments/feedback from students participating in the learning worlds project.

Nicole English

Fancy Interfaces: What Are They, and Why Do We Need Them?
~180 Words

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Abstract: Historically, there has always been resistance to new media. Even as far back as the invention of the printing press, there has been distrust of new channels of communication. Later, early film, radio, telephone, television, and more recently, digital technology, have all suffered the same distrust by government and society. All have been subject to legal constraints, licensure, controls, prior restraint issues, and social concerns. This fear and distrust of new media is historic, natural, and not unexpected. We should indeed be alert to the power and influence media has over our lives. This should not, however, deter us from pursuing or developing new channels of communication. Rather than be fearful of new technology and fighting or avoiding it, we should, rather, examine it in the light of what we have learned about dealing with new media in the past. Unfortunately, interfaces with this new digital medium, are still clumsy. The interface with technology itself is still a bit of an obstacle, and often, so is the expense of using or owning it. As these interfaces become better designed, more efficient, cheaper, more playful, simpler to use and understand, the more people will be better able to actually use the technology, creating more opportunity for interactivity.

BURKS 4: An Educational CD-ROM

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Abstract: This poster presents a practical demonstration of the 4th edition of the Brighton University Resource Kit for Students (BURKS), a non-profit product for students of Computer Science. BURKS is a self-contained website on two CD-ROMs for use on any IBM PC running Windows 3.1 or later.

BURKS includes tutorials, reference manuals, compilers for over 20 different programming languages, published papers, complete textbooks, a dictionary of Computing with over 12,000 hyperlinked entries, a copy of Linux (the popular free Unix clone for IBM PCs) and a large selection of other software. The entire collection (about 1.3 gigabytes of material) is also available online at *http://burks.brighton.ac.uk/*.

Since the CD-ROM is designed for use by novices, it includes a pre-installed copy of Netscape Navigator which runs directly from the CD with no need for a separate installation step, and which is configured with a set of helper applications to automate the process of installing software packages from the CD.

Tribal Computational Science Program

http://www.ahpcc.unm.edu/Alliance/Tribal/

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Abstract: The Native American Distance Education Community Website (http://www.ahpcc.unm.edu/Alliance/Community/) is gathering, cataloging, and distributing high performance computing programs, tools, and resources for utilization by Native American serving schools, colleges, and universities. Institutional technology infrastructures are being assessed, and a feasibility study is being created to support infrastructure-funding proposals for high-speed connections to the Internet2 (vBNS) Research Network. A computational science curriculum is being accumulated for use by both faculty & students. The teacher programs being designed will be used to "train faculty" to use the HPC programs, tools, and resources. The student programs are being designed to run "High School Student Programs in Computational Science" by utilizing these HPC programs, tools, and resources. The Albuquerque High Performance Computing Center is developing programs to reach Native American students in supercomputing and computational science, with emphasis on Internet technologies and other related distance learning technologies, in approximately 50 Native American serving schools.

Problem Solving With a Internet Database 'The Hit-List'

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Abstract: University Continuing Education, San Jose State University, has built a database using MSQL software. The database is used by the non-technical staff to enter their day to day computer related problems. This database, named "The Hit-List", resides on the department's Intranet and is checked regularly by the technical staff. Tasks to troubleshoot and resolve problems are assigned to different technicians according to their skill level. The database was designed using W3Msql interface, and is not dependent on any particular browser. The strength of the database is that it can be worked on from anywhere over the internet...

The database also helps the Director of Technology to manage and supervise the technical support staff. It can be determined that if a technician closes more tasks on the "hit-list," he/ she is consequently providing better service to the users. This helps to quantify staff evaluations, and can result in better biannual reviews and promotions. It also helps the Director to find out which technician is weak in resolving problems, and who needs to improve his/ her skills in order to help the customers more efficiently.

In conclusion, the database is very cost effective, and can meet the demands of the modern day web technology era. It is a fast, reliable and a very effective way of keeping in contact with our daily technical issues.

Acknowledgements

The author wishes to thank Marc Graham whose good will, enthusiasm and dedication helped design the database.

Eliminating Traditional Library Instruction: Requirements for the Successful Online Replacement

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Abstract: Interactive web applications offer academic libraries an effective platform for teaching basic library skills and can replace the traditional, and often unproductive, "one-shot" freshman visit to the university library. A new online headquarters for information literacy and library instruction under development at the University of Hawaii at Manoa Libraries will move beyond the earlier static web versions of bibliographic instruction and begin to engage the user in an active learning process through animation, feedback, and flexibility.

Successful web-based delivery of basic library skills instruction begins with careful planning, an organizational commitment to the technology, and attention to sound pedagogical practice. More specifically, the design should: 1) provide the user with the opportunity to interact with the lessons and receive immediate feedback; 2) allow for easy integration by faculty to course-related assignments; 3) be flexible and accommodate alternate learning styles; 4) move beyond simple mechanics of navigating a database or catalog; 5) bridge familiar experiences to new applications; and 6) provide clear and easy access to a librarian for further assistance.

Companies & Teleconferencing Tools: An Impact Study

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Abstract: The project *Teleconferencing*, part of the EC's ADAPT2 initiative, aims to study the potential of network technology, especially teleconferencing tools, in response to the need for intra-company and cross-company collaboration. The project was run by IMA-CNR, who drew up the project guidelines in partnership with eight companies representing a cross-section of the local economy in Liguria, a region in north-west Italy.

Liguria has been seriously hit by the general decline in industry; the reduction in heavy industry in particular has brought serious consequences, including high unemployment, demographic decline and ageing of the population. The socio-economic transformation underway calls for considerable flexibility, the capacity to exploit innovation and the fostering of exchanges and co-operation in order to open up new opportunities.

Within this framework, we carried out a survey to gauge companies' attitudes towards teleconferencing tools so that methodologies could be devised to exploit the potential for growth SMEs.

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NAU Web Course Evaluations; Online Learning from the Students' Perspective

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Abstract: Northern Arizona University (NAU) is the only university located outside major Arizona metropolitan areas. The universities mission is to serve rural Arizona through distance education initiatives. Recently NAU has added web courses to further serve a growing number of statewide students. It is recognized that to offer meaningful courses on the Internet changes to the organization of class materials and method of instruction have to occur. Student evaluation of web courses is key to understanding the impact of this method of delivery on the students and the institution. It is crucial for effective planning and to improve the web courses. More research must be done to continually improve the web courses and the methods for delivering class materials for the students to work on. This process has just begun at NAU and will continue. Results of the Fall '98 and Spring '99 semesters can be viewed at http://jan.ucc.nau.edu/~tdf/eval

Interactions Examined from Multiple Perspectives

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The first study sought to clarify ways in which active learning strategies were incorporated into the winner and honorable mentions of the Paul Allen Virtual Education Foundation's contest to identify outstanding online courses. Interactions emerged as critical in web-based learning. The diverse ways this was accomplished makes this study intriguing and valuable. Findings are organized in a theoretical framework based on the American Psychological Association's Learner-Centered Psychological Principles.

A second study analyzed the conversations in a bulletin board during a WebCT delivered course By mapping the various interactions it became obvious that certain individuals and topics elicit multiple responses and very rich interactions. An interaction analysis model emerged that is different from others that focus primarily on the types of individual interactions without a holistic view of the total conversation event. The patchwork quilt metaphor of Gunawardena, Lowe and Anderson (1997) is extended to a crazy quilt metaphor where patterns are less predictable and chaos seems to reign supreme!

Software for Supporting Virtual Classrooms

Kathy Gates

This SIG will focus on the evaluation, use and performance of integrated software applications for supporting virtual classrooms. Participants will share their experiences with these packages so that they and others can make informed decisions. This forum will provide an opportunity for faculty, administrators, and technical support staff to compare features, discuss support issues, and propose future enhancements. An important related issue is that of standards for on-line courseware, e.g., the Instructional Management Systems (IMS) project. Integrated software applications for supporting virtual classrooms are maturing and gaining in popularity and are facilitating the shift toward Web-centered classes. The investment in faculty time and effort to develop on-line course materials requires that institutions carefully consider the available options and choose wisely. This SIG will serve to guide participants as they make important decisions for their institutions.

Developing Multimedia-based Courseware:
A Student Team Member's Perspective

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Abstract

Developing multimedia-based courseware can be a very positive experience for students as members of a student development team. The roles of the student development team would be many. They would develop a contract with the content expert. They would develop a time line of activities and a production finish date. Development activities include organizing, flowcharting, story boarding, and authoring. They would arrange for and produce video, audio, and other forms of media. A learner verification review with potential users of the product is an extremely important and useful step. Multimedia development can be a totally self-directed and problem solving experience for those involved. The role of the facilitator and content expert is to be responsible for determining goals and objectives for the content, and also to oversee the team's progress. The facilitator's responsibility is also to provide equipment and advice for development.

Business German and the WWW

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Abstract: With the Worldwide Web of the Internet, businesses and governmental organizations present their products, services or information to a large audience. The material found on the WWW is rich in possible pedagogical uses and current. Students enjoy applying concepts to tasks involving the WWW, reading and understanding the target foreign language vocabulary in the context of the real world, and continuing the learning process by finding their own WWW materials for assignments. This demonstration provides an introduction to the pedagogical assumptions and methodology involved in undergraduate instruction of business-oriented foreign language courses involving the WWW, with assignments for Business German and German websites used as examples. The Metropolitan State College of Denver offers a two-semester course sequence in Business German. Business students pursuing German language skills, students minoring in German and native German speakers interested in the topic of Business regularly select these business-oriented advanced foreign language seminars.

Catch the Stars in the Net!
Project for Astronomy Education and Outreach via the Internet

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The Web site "Catch the Stars in the Net!" (www.pd.astro.it/stars) represents the "visible" part of a more complex project of didactic and popularisation of Astronomy via the WWW, managed by the Astronomical Observatory of Padua (Italy). It is presented here in its English version.
Our aim is to meet the needs of all the users whether they are looking for information regarding concepts of Astronomy.
The site is composed of "module" of didactic or popular behaviour, organised in different levels of complexity and depth. The exposition of its contents and themes (i.e. didactics, outreach, history, curiosity/news, information) has been carefully developed. Each module is tested "on the field" on a sample group of students, teachers and selected users before publication.
The site is completely created and managed by professionals in Astronomy, with whom is possible to interact via Net, so guaranteeing valid educational methods and scientifically correct contents.

Developing New Therapeutic Recreation Web Sites

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Abstract:

How are the over 30,000 people employed in therapeutic recreation staying current in their field? A number of therapeutic recreation professionals have designed web sites with information specific to the therapeutic recreation field. The two national organizations (ATRA and NTRS) and the national certification council (NCTRC) also maintain web sites. In addition, a few therapeutic recreation professionals maintain up-to-date web sites with agencies now developing their own web sites. Although these sites exist, it is sometimes difficult to locate them. This poster session will introduce five existing therapeutic recreation websites at the University of Wisconsin-La Crosse that are related to accessing therapeutic recreation information over the World Wide Web. These sites include project TRAIN (Therapeutic Recreation Access to the Internet) TRIPS (Therapeutic Recreation In Public Schools), WINTR (WIsconsin Network of Therapeutic Recreators), TRIC (Therapeutic Recreation Internet Connections) and TREAT (Therapeutic Recreation Educational Access to Technology Sources). All of these sites can be accessed at: http://perth.uwlax.edu/hper/RM-TR/three.html

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Weaving a New Web:
Identifying Resources for Virginia Educators and Education Leaders

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Introduction

"Very few web resources are indexed to curricula, state frameworks, or national standards" (Roschelle & Pea, 1999, p. 23). In reviewing a series of issues related to the potential of the World Wide Web in education, Roschelle and Pea discussed the need to "tune" resources more closely to specific situations. They added, "The cost of identifying relevant resources on the web is much too high for overburdened [educators] to undertake" (p. 23). While there are a growing number of web-sites that provide links to education resources on the World Wide Web, the sponsors of the majority of these initiatives have not specifically connected their content with the needs and interests prevalent within a state. With this problem in mind…

VITaL, the Virginia Initiative for Teaching and Learning, is being developed as a web-based clearinghouse of up-to-date information pertinent to the needs of educators and education leaders in Virginia. The project, which is in the early stages of development, will focus on identifying World Wide Web resources and organizing them according to state education interests and initiatives. Providing teachers and education leaders with resources pertinent to state's education agenda will enhance their ability to "locate, communicate, and process information" that may allow them to "become more proactive in approaching [education] challenges" (Donatucci, 1995, p. 14).

Web-based Object Oriented Multimedia Assessment System

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The need to separate the content and programming logic during the question development stage in the implementation of computerized assessment is inevitably necessary in view of the technology proficiency of the end-users, cost, development time and pedagogy issues.

This paper presents the use of object oriented technology in the implementation of a Multimedia Assessment System. It will report on our applied research project currently being carried out at the polytechnic to create re-usable question templates for easy creation of multimedia question items. It will also discuss how contents and testing strategies could be separated and form re-usable resources. The session will present a complete architecture of the system, inclusive of the component of administering mastery learning tests and generating test papers of similar difficulty level and reliability indexes. The full benefits of the system and difficulties encountered during the implementation will be discussed.

Selection: Individual Diagnostics in Personnel Selection and Consultancy

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Selection is part of a large scale project that aims to enhance the skills education in the study of Psychology. Training takes place in advanced courses for professional conversation skills in, among others, personnel selection and consultancy. The program Selection shows the student the proces of selection and the tools available (techniques, methods, tests, etc.). It focusses on teaching diagnostic and conversation skills in an interactive manner. The student has the role of a junior consultant and with the guidance of a virtual senior advisor he has to select the most eligible person applying for a job. When students are finished, the skills are practiced in threesomes under supervision of a teacher. The program is distributed via an Intranet and multi-media elements are used extensively. A preliminary evaluation has shown that students are satisfied with the contents of the program and enjoyed doing it, and think it represents the professional practice very well.

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The Ecology of Education:
Creating the Natural Environment for Inductive Learning

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Abstract

Since time began, humanity has sought to manipulate their environment to minimize the impact of the unpleasant forces of nature upon the frailty of the human body. It began with primordial man learning inductively through discovery rather than applying known laws or theorems. Today the inductive process is largely lost in the field of electronics where complete circuits are provided in school labs and industry.

In remedy, this author provides an inductive learning 'game' by modularizing electrical circuits into cards that are placed from left (input) through the microcontroller to right (output). By simply modifying (amping or dividing) voltage (V) and current (I) between each card, students design and can build sophisticated circuits that control the forces of nature in real time [Tab. 1]. It is the microcontroller programmed in 'C' that defies nature. Today, the final frontier is global Internet control of these local 'micro' masters of nature.

Table 1: Forces of Nature Under Control.

Forces of Nature	Input Devices	Output Devices	Application
1. Magnetism	Hall Effect Sensors Digital Compass	Motors Servos Inductor Coils Relays	Compass for magnetic north
2. Light	Phototransisters, Photoresisters Solar cells, Photodiodes	LED Incandescent Florescent Laser	Identify moving objects by motion sensor device
3. Rotational Motion	Generator Alternator Dynamo	Actuator	Determine speed (RPM) of engine
4. Pressure	Piezo Conductive material (foam)	Servo Muscle wire	Measuring the force of water, air, or wind.
5. Temperature	Thermister, Thermo couple	Heater coil Refrigerator Thermo Pile	Thermometer
6. Sound	Microphone Piezo	Speaker Piezo	Sonar distance sensing
7. Gravity	Accelerometer Tilt sensor Digital scale device Pendulum motion	Bent gravitational fields	Bringing back in the Shuttle
8. Conductivity	Proximity sensor Conductivity meter	Electrolysis	Presence of human in door way
9. Radio Frequency	Radio antenna and receiver coil	Radio transmitter coil	Remote control using RF
10. Friction	Digital scale device	Resistant motion	Tire traction

Lone Star 2000: Creating a Web-based Collaborative University and K-12 Learning Environment

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Abstract: This educational technology project enabled teacher educators at the University of North Florida to establish a successful collaborative educational partnership with several accomplished elementary and secondary science teachers in the Duval County Public School District in Jacksonville, Florida. The project received funding from the Corporation for Public Broadcasting, IBM, Logical Business Sytems of Jacksonvile, and MediaOne.The main goal of the project was to improve science teaching and learning for K-12 students and preservice teachers using educational technology. The participants received training in multimedia production and advanced educational technologies, including videoconferencing and the world wide web This conference presentation will feature work products produced by the participants, including web site work, electronic portfolios of preservice teachers, and web-based portfolios of K-12 students.

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Classroom Access Through Technology: Accommodation Solutions Online

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The Americans with Disabilities Act has made it necessary for universities to provide increased services to students with disabilities. The Accommodation Solutions Online website provides easily accessible information concerning accommodation solutions for various classroom environments, assistance to the faculty in providing Braille, raised line drawings, etc., provides expert advice on accommodations questions, and includes a searchable database on hardware/software solutions to accommodation challenges. In addition, the website provides campus maps that highlight accessible routes, restrooms and entrances and a resource guide to accessible restaurants, churches and other community resources.

CONGA: Information and Consulting System for an International Degree Course

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Abstract: In 1997 the internationally master degree course „Computer Science and Communications Engineering" started at Gerhard-Mercator University of Duisburg. This degree course aims at students of all nationalities and offers several innovations to the German university education system: lectures are equally offered in German and in English language, the possibility to enter the degree course in a higher semester due to an international bachelor degree and the obligation for German students to stay abroad. Also, the students have the choice to receive either the German „Diplom Ingenieur" degree or the international degree „ Master of Science". The degree course itself has a reform character and already turns to be an object of research during its five year pilot-phase. Additionally, new methods for transferring knowledge are to be created and applied (Hunger & Werner, 1998a). Further information about the degree course can be found in (Hunger 1998). The set-up of international degree courses is a first step towards the globalization of university education which requires other steps to be followed. This article presents the thought of and partly already realized steps taken in Duisburg.

1. Introduction

The setup and introduction of new degree courses requires efficient tools to support different target groups. Students on the one hand and academic staff on the other hand represent these target groups. For the preparation of the studies, students have to be supported in finding information, in decision-making, in dealing with all the formalities when entering the country or filling in the application forms. The academic staff has to be supported in administrational problems, e.g. project administration and documentation, as well as subject-based questions, e.g. questions about the acknowledgement and classification of students, who have already earned a degree. A further aspect lies within the worldwide advertisement for this degree course. Therefore special tools are needed. The conception and implementation of these tools is done within the Conga Project (**C**ourse **ON**line/Offline information and **G**uid**A**nce System). In doing so, we make use of different media as CD-ROM for advertisement and student information purposes, several Data Bases for planning, administration and documentation purposes and Internet for our self-projection and student advisor and information purposes. The separate systems are realized in different parts of the project. The CD-ROM was originally created to be shown at educational fairs. In the meanwhile it proved itself being an integral part of the information package. The CD titled „Living and Studying in Duisburg" contains in the current version: videoclips showing foreign students who study in Duisburg saying words of welcome in their native language, general information about the degree course, the curriculum of the degree course, a description of the contents of the offered subjects, information about Gerhard-Mercator University (articles, pictures, video) and information about the city of Duisburg (articles, pictures) A detailed description of the CD is given in (Hunger & Werner, 1998b). The set-up of different database applications and the internet connection takes place within the scope of the CONGA project. This parts will be described in the next two sections.

2. Conga-DB

Planning of new degree courses and study rules is marked by producing and updating tables and documents. The number depends on several parameters, for example the number of courses to deepen the studies in, the complexity of the electives catalogue. Furthermore, different point of views concerning the data holding demands distinct tables which contain the same information though. The database contains personal data of lecturers, student data, characteristic data about the degree course, as well as data and description of the subject contents.

The effort necessary for updating the data is closely linked to the number of views at the data holding. apart from the application for updating the database further applications are needed for planning and administering new study courses, for generating study plans, for generating personal study plans and schedules, for time- and room-planning, for realizing experimental games and to help the study advisor with questions about acknowledgement and classification.

3. CONGA-Web

Informing and advising students has an outstanding importance in the globalization of higher education. In the case of our degree course most of the students received their first information via the internet. Applicants from foreign countries get into first contact almost exclusively by e-mail. An information- and advise center should be build up within the scope of CONGA-Web, which not only supplies the student with organizational and subject-based information. The system also deals with standard consultations and therefore helps out students with their choice of degree course and place. Thus, the set-up of an intelligent WEB-information-system is planned. The system consists of a WEB-site, an internet database and a knowledge base, including rules. The Web Site contains all relevant information concerning the degree course as well as an agent-based consultation system.

The internet database is a connection to the Conga-DB database and thus has access to the above mentioned data. To adjust curricula of other universities, it is planned that the database contains their curricula and the matching offers. The rule base contains conversion tables for credit point systems and rules for acknowledgement procedures. This system enables students to inform themselves extensively ahead of time. During the next step, students can be advised interactively, after entering their personal background. Students, who have already reached a degree, can be classified according to the database and the general basis, and a plan can be made about the course of study. All the other forms, e. g. application forms, help with applying for the visa etc. can also be done system-based.

This system is especially interesting for students who have already started or finished their studies. For these students the system offers as result of the consulting a study plan for the degree course in Duisburg. The student has to give details about his studies so far. He needs to assign his achievement in the different subjects to the curriculum of Duisburg. This information is collected in a cookie in the students' system and transferred to Duisburg for the final evaluation. The student is supported by an intelligent agent throughout the entire session. The comparison of foreign curricula with the curriculum in Duisburg is one of the most difficult parts to be implemented in the consulting system.

4. Summary

This article presented tools to support the planning and the set-up of international degree courses. Tools for the LAN environment have been used successfully since the winter semester 1998/99. The tools for self-projection and advertisement are being used since the beginning of the course and are constantly updated. Current work deals with the implementation of the student consulting system. This module represents an essential innovation of the system in comparison to the usual practice.

5. References

Hunger, A. & Werner, S. (1998a) Possibilities and Limitations of a Computer Supported Cooperative Learning Environment within a Spatially Distributed Practical Training. In *Proceedings of the Euromedia '98*, SCS Publishing, 235-237.

Hunger, A. (1998) The Concepts of the Internationally Orientated Degree Course ‚Computer Science and Communications Engineering' *Proceedings of the International Conference on Engineering Education 1998*, August 17-20, Rio de Janeiro

Hunger, A. & Werner, S. (1998b) A Course Curriculum and a Multimedia Concept for an internationally orientated Degree Course. In *Proceedings of the CATE '98)*, IASTED/ACTA Press, 25-28.

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Integrating VRML and Java to Build Practice Environments

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Abstract: This presentation will describe how to create meaningful 3-D web-based practice environments using JAVA and the Virtual Reality Modeling Language (VRML). VRML provides an interactive 3-dimensional (3-D) world where the user can learn by discovery and by doing. JAVA adds the ability for a practice environment to coach and guide the learning process. Integrating JAVA with VRML adds the power of dynamic assessment, coaching, and feedback so the user can understand and analyze his actions in the 3-D VRML world. A mechanical skills training example is used to illustrate the 3-D practice environment.

References

[Johns 1999b] Johns, J., (1999) *Teaching Mechanical Skills with 3-D VRML Practice Environments*, Journal of Interactive Instruction Development, Volume 11, Number 3, pages 9 - 18, Winter 1999.

[Johns 1999a] Johns, J. (1999). *Web Based Practice Environments to Teach Mechanical Skills*, The Interactive Multimedia Electron Journal (IMEJ) of Computer Enhanced Learning, Association for the Advancement of Computing in Education, http://imej.wfu.edu/articles/1999/1/01/index.asp, April 1999.

[Johns 1998b] Johns, J. (1998). *3-Dimensional Practice Environments for Mechanical Skills Training*, Conference Proceedings, The biennial Conference of the Australian Society for Educational Technology, Perth Western Australia, ISBN 0-86905-640-9, pages 79 - 85, July 5 - 8 1998, http://cleo.murdoch.edu.au/aset/confs/edtech98/pubs/articles/j/johns.html.

[Johns 1998a] Johns, J. (1998). *Improving Perceptual Skills with Interactive 3-Dimensional VRML Scenes*, Journal of Interactive Instruction Development, pages 3 - 11, Volume 10, Number 4, Spring 1998.

[Johns and Brander, 1997b] Johns, J., Brander, J. (1997) *Improving Perceptual Skills with 3-Dimensional Animations*, Journal of Instruction Delivery Systems, Volume 12, Number 1, pages 8 - 19, Winter 1998.

[Johns and Brander, 1997a] Johns, J., Brander, J. (1997) *Multimedia Techniques to Teach Mechanical Skills*, Journal of Interactive Instruction Development, Volume 9, Number 4, pages 29 - 37, Spring 1997.

Academic Library Instruction Using the WWW

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Web-based library instruction holds great promise. Students can access the details they need, and take "side trips" to related tasks or information at their own pace, as they follow a research strategy mapped out by a librarian. Instruction can be delivered remotely (at any hour), information can be easily updated, and there is no competition for classroom instruction time—all shortcomings of other library instruction methods. Faculty and librarians traditionally have collaborated on the type of library instruction that students need in conjunction with their courses. With web-based instruction, there can be more encompassing instruction in "information literacy" skills. The web page format enables the seamless integration of skills related to library research. Internet research skills, computer skills (i.e., downloading, reformatting, using graphics), and writing instruction can all be incorporated into the "library instruction" web page by collaborative effort from the faculty, library, computer lab, and writing center.

Low-Tech Classroom Management Through the Web

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As an ESL teacher with a limited amount of classroom contact, I found myself spending too much time "managing", taking large chunks of limited class time for non-instructional tasks, which were done in-class due to a lack of opportunities for them outside of class. However, once in a situation that made computer applications a possibility for all students, I was able to explore ways of maximizing limited classroom time through Internet applications. The three main applications are posting lecture notes/explanations, posting answers to exercises and moving in-class exercises to the Web for outside work.

Low-tech is emphasized for two reasons. First, many educators are relative newcomers to computing and are often frightened off by excessive high-tech. Second, many schools lack the budgets to purchase state-of-the-art computers and thus many high-tech applications are not possible. The Internet is a valuable educational tool, but often the most valuable tool, and certainly the most utilized, is the simplest one.

For more detail, please follow links at http://www.u-aizu.ac.jp/~luther

Two Different Approaches to the Distance Learning

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Abstract: In today's world new knowledge is produced very fast and if we are trying to be at the top we have to update learning material every year. Traditional book printing is too time consuming and too costly for frequently updating. For this reason we put one of the most important thing in the distant education - learning material to the Internet. There is no prescription how to do this nor which technology to use for producing Internet learning material. We are presenting two different approaches. One is the oldest known to the Internet (pure HTML) and the other one is one of the newest (Java applets). The first approach is used in the environment where students have almost no programming experience and the other is for computer science students. We highly recommend using the technology that allows students to actively participate in updating learning material – "live" learning material.

An Inquiry of the Social Functions and Social Interaction in the Internet

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The internet is a product as well as a shaping part of modern societies. As such it chances social structures and interactions. The Cyberspace provides new opportunities for participating in seeking, organizing, presenting, talking about and creating information in many ways. I identify six social functions of the Internet: the function of communication, the function of a mass media, the function of a workplace, the function of a marketplace, the function of social interaction, and the function of socialization and education. The nature of global communication and information exchange in the Internet can be considered as immediate, overwhelming, and to a large degree uncensored. Although the participants in the WWW have already internalized social norms and values of the society, new customs and norms of social interaction are created through the communication in the Internet. The Internet promises to be a source of infinite global information. Therefore it may shape the perspectives of the participants.

An Inquiry of the Social Functions and Social Interaction in the Internet

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An Interactive Learning Environment Based On Cases

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ABSTRACT: This presentation is related to the design of multimedia systems for vocational training in domains involving problem solving in contextual situations. Medical diagnosis, catering duty and companies' management have first been studied for several years. These activities involve several kind of theoretical knowledge but overall the heuristic aspect seems more and more prominent. In fact, a major difference between novices and experts will be the ability of these latter to exploit the *context* and link together *similar* situations. In order to tell about contextual situations, we have defined within a particular apprenticeship environment: an interactive learning based on cases. The aim is to enable the learner to experiment " real " situations in an adapted pedagogical environment. The WWW version is under progress to constitute teaching platform. The students would be able to get the complementary and enriched pieces of information through the access to data banks, and they would be able to dialogue with a distant teacher, tanks to the e-mail.

The ADDIE for ACTIONS Model Matrix:
A Tool for Decision-Makers in Distance Education

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Distance education, which may once have been thought of as insignificant to the survival of an academic institution, can no longer be ignored as vital to an institution's success and reputation, and possibly even its existence in the new millennium. The student market which was once reserved for traditional institutions is now being preyed upon by competition from both public and private non-traditional, educational providers [Olcott 97]. Therefore, key decision-makers at both small and large traditional institutions are being forced to implement distance education programs to be more competitive in the marketplace. The authors will present The ADDIE for ACTIONS Model, which combines The ACTIONS Model [Bates 95] and The ADDIE Model [Rossett 87], that decision-makers can use when implementing a distance education program.

References

[Bates 95] Bates, T. (1995). *Technology, open learning, and distance education.* London: Routledge.

[Olcott 97] Olcott, D., Jr. (1997). Renewing the vision: Past perspectives and future imperatives for distance education. *The Journal of Continuing Higher Education,* 45(3), 2-13.

[Rossett 87] Rossett, A. (1987). *Training needs assessment.* Englewood Cliffs, NJ: Educational Technology Publications.

« Graphs à la carte »
Scientific graphs dynamicly generated on the Web.

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Abstract : The space experiments generate a huge amount of data that are only easily exploitable using graphic representations. So, the CNES (French Space Agency), that provides space scientific data access through the Internet, has developed a tool which can interactively generate graphs on a Web page, using Java and PV-WAVE.

"Graph à la Carte" provides to the user à JAVA applet. This applet first calls a CGI script that returns the names of the graphic modules which are available for the chosen data (the available types of plottings).

The user then, just has to compose the Final Plotting by adding different graphic modules and parameters. The image is calculated by PV-WAVE and then returned to the applet to be displayed.

The Construction of a Supportive WWW Web Site for Australian Primary Science Teaching

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Abstract: Previous studies indicated that Australian primary science teaching had been in a state of crisis. Teachers need more support to strengthen their background scientific knowledge and skills, to design programs, to access teaching resources, and to find answers for their questions quickly. A web site has been set up on the Internet in which seven science-units were constructed in the homepage formats. The characteristic of each science unit is its theme-based contents that link to other Key Learning Areas in Australian primary curriculum. Each unit also contains template program overviews, links to teaching resources, links to other Internet lesson plans, links to frequently asked questions, links to experts and news discussion groups, and links to fun sites for kids. This research demonstrates the educational potential of the WWW in primary science education to overcome some of the Australian primary school teachers' difficulties and to meet their needs.

Online Activities for Research: Science with OAR

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Science with OAR is a collaborative effort between the University of South Alabama and the Office of Oceanic and Atmospheric Research (OAR). The purpose of this project was to work with middle school science teachers to design and develop 12 interactive lessons for students in grades 5-8. These activities focus on several of the major topics consistent with ongoing OAR and National Oceanic and Atmospheric Administration (NOAA) research efforts. Students are involved in gathering information and data from actual NOAA sites on a variety of topics. They use this information to complete activities and conduct science investigations related to topics they are covering in their science courses.

Creating a Personalized Web-Based Library Tour

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Abstract: Unlike other Web-based library tours, the Colorado State University Libraries Virtual Tour [http://manta.library.colostate.edu/tour/] permits customization options allowing different users to access information that suits their needs and experiences. Users may select various access points, including a pre-arranged order, an alphabetical list of stops, an arrangement by floor, or may assemble a customized list of tour stops. Each tour stop features a photo, a map, bulleted information, and links to in-depth information. While designed for maximum accessibility, the tour also offers optional high-bandwith features like 360 degree panoramic views, audio segments, and JavaScript enhancements. A brief interactive quiz at the end of the tour checks for retention of basic information. This customization has numerous benefits including an interactive, more personalized tour experience for users and more classroom time devoted to library instruction, rather than physically navigating the building.

Web-Based Instruction in Geographic Information Systems

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A Geographic Information System (GIS) creates and analyzes digital maps and other geographic data, and the Web provides a natural medium for teaching GIS. My GIS classes use the Web as a medium for participation in problem-based learning (PBL) labs.

I deliver all course materials via the Web, and for the past four years I have also required students to submit all of their class projects via the Web. I encourage students to write raw HTML to de-mystify it, and to learn digital image basics by experimenting with Xview (UNIX graphics editor). Web-authoring skills empower students. Each class session begins with a brief lecture followed by a PBL lab session. Students demo their work on the Web, critique each others' work and develop on-line portfolios. My GIS classes now require more instructor and teaching assistant time than previously (and more student time!), but they earn very high student evaluations.

A SOFTWARE TOOL FOR EVALUATING NAVIGATION

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ABSTRACT: Traditional methods of usability evaluation ignore some aspects related to navigation. In contrast the navigation in information space paradigm sees the user as situated within the space. The ENiSpace (Evaluating Navigation in Information Space) system builds on a paper based checklist to support designers in addressing navigational issues. The software version also includes reporting features, supporting documentation and references the aim being to inform design as well as to provide a method of evaluation. The current version consists primarily of the checklist, however the completed version will include collaborative evaluation features via an internet server.

Intranets in the K-12 Arena: Establishing a Process for Developing a Distributed Learning Environment

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Abstract: Corporate America has rapidly embraced the concept of an intranet; however few developers have considered the potential uses of an internet-based communication and distributed publishing system in the elementary and secondary school settings. We will focus on the process of implementing an *instructional* intranet in a public school system from the evolving conceptual framework to the deployment of a state-of-the-art communication and publishing system.

In this session we will share how we have responded to the challenges of adopting a distributed learning environment, most of which can be broadly categorized as balancing competing demands. Issues related to understanding and committing to the level of support required to maintain the environment, accounting for access issues, and the protection of learner privacy will be explored. In a greater context, we will examine how this powerful technology might be used to revolutionize learning environments and support learning communities.

Acknowledgements

The development and implementation of the Franklin County Public Schools intranet is supported by the United States Department of Education and the Technology Innovation Challenge Grant Program. All statements made, and the views expressed are solely the responsibility of the authors.

trlA Web-based RelationalDatabase-backed Exercise and Quiz Delivery System

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Abstract: Aninteractive web-based system is described which allows the construction andediting of quizzes, delivery of quizzes, provision of user feedback andrecording of user performances. Questions and responses, exercises, client details and performance statisticsare held in a server-side database. An input system is provided tofacilitate the construction and editing of quizzes via the WWW. The systemdescribed here has been implemented as a Microsoft Active Server Pages (ASP) web application. Thiswork contributes to the second phase of on-going research into higher levelauthoring tools. The web pages produced in this version concentrate onfunctionality with little attention being paid to presentation issues; versions built inrelated projects enable presentation characteristics of pages to be definedand edited and the corresponding HTML source to be generatedautomatically.

An XML-based Generic Architecture for the Construction of Interactive Web Components.

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Abstract: A generic architecture for constructing interactive web-based components or subsystems is described. Examples of component types are custom content navigation and presentation components, interactive exercise and testing components, and an electronic catalogue and ordering system component. The instances of a component type are collections of structured data which share a common syntactic and semantic model. The data model for a component type is described using an XML Document Type Declaration (DTD). The data of a component instance is stored and described by an XML document conforming to the component DTD. An interactive component combines the content data with behaviour and presentation characteristics. A generic architecture has been developed using an XML and CSS-based modelling language for describing and mapping data objects to layouts, styles and behaviours. A generic runtime engine reads, parses, loads, instantiates and renders the described model into DHTML/HTML at runtime, or statically during authoring. The runtime engine itself can be implemented on either the client-side or server-side. Simple authoring tools can be developed on top of the architecture to automate the construction process.

Application of WEB based Interactive and Multimedia Technology in an Introductory Engineering Course

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Abstract: Statics, an introductory core engineering course was developed as a web based course. The course contains animated GIF, Java based animations, 3-D models using Virtual Reality Modeling Language (VRML), and interactive tutorials and examples to demonstrate the principles of mechanics in a more dynamic and interactive form. The primary emphasis was on using the site as a supplement to the regular class lectures. The web-based course is geared towards interactive problem solver (IPS) and analysis models where the student can actually solve myriad of problems on a specific topic till he/she has a better understanding of the concept. The interactive problem solver keeps a track of the number of attempts made by the student and the content of the trials. This facilitates the instructor in grading the student and structuring the course review as the course progresses. The web site also includes the lecture notes for review. (http://www.ent.ohiou.edu/~statics)

The Virtual Psychology Laboratory: A Web-Based Resource For Researchers and Educational Users

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Abstract: The Virtual Psychology Laboratory (VP-Lab) is a collaboration between the School of Psychology at Cardiff University, the Computing in Teaching Initiative (CTI) Psychology Centre at York University and the Data Archive at Essex University, funded by the UK's Economic and Social Research Council. The intention of VP-Lab is to archive experimental psychology data and materials so that they may be located and downloaded by interested researchers and students. VP-Lab is accessed via the World Wide Web using a standard HTML browser. There are several different target audiences for VP-Lab. Firstly there are research psychologists who wish to, or are required to, make their data available. Researchers may also wish to access other's data or materials, perhaps to do a meta-analysis or when trying to gain a more comprehensive understanding of materials described in a published paper. A second audience consists of those who are teaching or studying psychology. The poster presented at WebNet 99 describes VP-Lab and focuses on how educational users might benefit from using it.

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Web-Based CAI for a Distance Education Neurology Course

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Abstract: At the University of Illinois College of Medicine at Rockford, the Rural Medical Education Program prepares students with the special knowledge, skills, and attitudes to be successful as Family Physicians in rural Illinois. Students in this special medical education track spend four months off-campus on a rural preceptorship under the supervision of a practicing rural family physician. This poster session presented an instructional unit that was developed to provide these students an opportunity to complete their required senior neurology clerkship off-campus. This unique distance-education neurology course provides a focused tutorial on the neurological physical exam plus sixteen WWW-accessible case studies whose medical content is identical to the paper cases used in the traditional clerkship. The unit proved to be an effective vehicle to support mastery of a defined set of learning objectives in neurology. Most participants expressed interest in further web-based courses after this initial experience.

Identification of Swallowing Patterns Associated with Dysphagia

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Abstract: The present project was designed to allow graduate students to observe swallowing patterns (both normal and disordered) through the World Wide Web. This web site utilized QuickTime technology to present these video segments as actual video segments. This web site deals with the diagnosis of disordered swallowing patterns commonly produced by dysphagic individuals. Students in communication disorders must evaluate swallowing disorders and determine their relationship to the anatomy and physiology of the swallowing mechanism. In order to perform this role successfully, the student must be skilled in evaluating the interpreting radiographic studies of patients with swallowing disorders. The student must learn to be a reliable observer and to recognize, describe, and interpret evidence of anatomical and physiological conditions that are provided by the swallowing patterns. As the student learns about the different swallowing patterns, it is helpful to have visual tutorials that supplement classroom presentations in order train students to become proficient observers in determining the presence of specific swallowing problems.

A Visit to Purdue University Via the Web

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In the summer of 1998, the Department of Computer Graphics began developing a web-based informational and marketing resource for individuals interested in attending and visiting Purdue University's West Lafayette campus. The result is an interactive campus map that provides information about the various campus buildings using text, photographs and VR movie clips. It also provides the ability to search for specific buildings and locations and an online-guided tour. The site allows the user to navigate the campus using a unique, vector-based graphical user interface. The completed interactive map, titled *The Purdue University Virtual Visit*, became available in August of 1998. Since that time the university has supported the project through various grants, which has allowed many features to be added. This contribution displays the project and its associated features.

Empowering Educators with Intelligent Web-based Productivity Tools

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Abstract : With the advent of the Internet, educators now have access over the web to the first artificial intelligence productivity toolsites. This presentation will demonstrate a unique online lesson planning toolsite and a research toolsite where educators actually create documents in the website. Following a process guide, the user applies a natural language retrieval algorithm to locate educational resources and to align lesson plans to district, state, and national standards. The research toolsite educators retrieve educational literature using this same natural language query system. The benefits of this approach include: 24-hour access to user documents from any Internet computer; intelligent search and expert system features; no software installation requirement; and instant access to new features and data, such as instructional resources, new lesson plans, revised standards, and current research documents. Future application include assessment systems, direct instructional systems, and comprehensive school management systems delivered totally over the Internet with web toolsites.

Development and Operation of a Website for Enhanced Artificial Intelligence Applications in Medical Diagnosis, Treatment and Prognosis

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Abstract: Medical diagnosis and decision making is rather an empirical than a statistical process. Improvements in artificial intelligence methods (Neural networks, fuzzy systems, genetic algorithms) have opened a new way for developing *Medical-Decision-Support-Systems*. As there is no established communication platform in this specialized research field, the authors designed a "virtual-text-book" for interested specialists from both the medical and the mathematical discipline. The site contains the following chapters.

Neurons/networks:	introduction/backgrounds
Networks/models:	mathematical treatment
Neural networks @work:	*PENN*-application for Hook-Effect-Detection
Literature:	search in literature- and patent-databanks
Medicine/AI:	medical information, data collection, alternative AI-methods
Neural networks:	training program, links to other Neural network information sources

The present development intends to establish a *"Community"* working on the application of artificial intelligence techniques in medical diagnosis and decision making. Topics are the communication platform, medical databases, training and evaluation, announcement of new methods, mathematical aspects, standardized application interfaces. Representatives from industry are invited to test the Neural network algorithms/tools for implementation into automated diagnostic systems.

Object Oriented Analysis and I*net Applications: an Experience-based Approach

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Abstract: One of greatest problems in building I*net applications is the lack of a model that matches the Object-Oriented Analysis and the particular characteristics of I*net applications. Traditional analysis' methods often fail in predicting performances, in creating screen layouts, and in some other important operations: there is a traceability gap between analysts' requirements and technological constraints. We present here our Work product structure to integrate an I*net analysis [Zeffiri et al., 1998] to the OOTC's approach to software development [IBM Object-Oriented Technology Center, 1997], in order to manage correctly every impact of I*net technologies in the software production.

References:

IBM Object-Oriented Technology Center (1997). *Developing Object-Oriented Software - An Experience-based approach*. Upper Saddle River, NJ: Pretience Hall, Inc.

Zeffiri, S., Cali, F., & Morandotti, P., (1998). A Practical Approach to Intranet and Extranet Applications. *Proceedings of WebNet 98 - World Conference of the WWW, Internet & Intranet, Abstracts*. 96 Association for the Advancement of Computing in Education, Charlottesville, VA. The original submission is available at: http://www.intrasoft.it/Webnet98/Zeffiri.html (last download: June 25th, 1999).

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ScienceSite: Building the Perfect IT Learning Tool

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Abstract: ScienceSite© is a small program, which adds "advanced" features to normal html pages. It is not an html editor - you are still free to use which one you like - but it provides you with a simple, user-friendly interface that automatically generates a menu structure with onmouseover facilities, offers a dictionary feature that makes a link out of every word which have been put into the dictionary, and offers the possibility of different views. Furthermore the program generates smartlinks© - links pointing to pages with related content, and you can easily shift between different languages. Everything is built on metatags. By changing the metatags, you change the way the content is presented.

ScienceSite is made by Learning Resource Center, The Technical University of Denmark.

The Web-based Integrated Science Environment (WISE): Connecting to the World

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We will present an ambitious extension of the WISE Project in which we adapt the WISE technology and curriculum for use in school systems around the world. Educators from several nations have expressed an interest in having their students, teachers, and schools be a part of our new and exciting ideas for science instruction. Visiting scholars from Norway and Israel have already begun the process of translating curriculum, and scientists from other countries have approached our project to inquire about similar collaborations.

The WISE Project has responded to this interest by developing a powerful model of internationalization. This program involves the translation of WISE curriculum activities and professional development materials, the training of foreign staff correspondents, and the set-up of devoted server technologies. We will describe how this model was developed in the course of a single collaboration with Norway, then generalized for use in other countries.

Friscawai'i: A Trans-Pacific Classroom Web Collaboration

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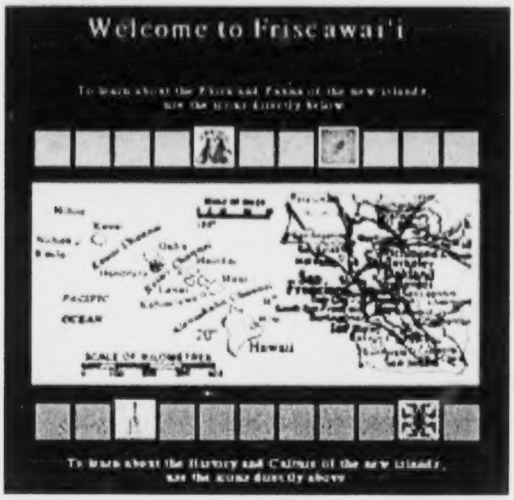

Welcome to Friscawai'i

To learn about the Flora and Fauna of the new islands, use the icons directly below

To learn about the History and Culture of the new islands, use the icons directly above

"Friscawai'i" Opening Screen, February 1998

Artists Violet Murakami and Mike Mosher planned to see their classes collaborate on an internet-based art project in Spring, 1998, when Violet taught at Kapi'olani Community College in Hawai'i and Mike taught at San Francisco State University in California.

The concept behind "Friscawai'i" was to create a site for the "Culture" and "Nature" of a fictitious nation created by sesimic cataclysm that moved San Francisco to rest beside the Hawai'ian islands.

Each student was paired with a partner to send and receive three statements via email about "the other side", and then to construct an image and text from that information.

The instructors intended students to take a critical stance in this artwork, and even to question the trustworthiness of online communications. Yet "Friscawai'i" was hobbled by students' differing senses of time, priority and classroom curricula.

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Business English on the Web for M. Sc. Students

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Abstract: For teaching English the Web is an endless resource of study material and a useful tool for communicating. This goes especially for Business English, as most of the business letters are sent by e-mail and it is common to have international business meetings using videoconferencing programs on the Web. The purpose of this poster is to present an action research on the use of the Web in language teaching, and also to demonstrate the Web design of Business English course in Pori School of Technology and Economics, Finland. The experiences from the pilot project in August-October 1999 are described comparing two study groups. The first group consists of part-time M. Sc. students that participate in the Web course, and the second group of full-time students that participate in normal classroom tuition. The results are shown, aiming at giving some advice for the design of future languge courses on the Web.

The Bulletin Board as a Tool for Curriculum Development

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The National Science Resources Center developed a Web-based bulletin board for teachers who were field testing four new curriculum units in the Science and Technology Concepts for Middle Schools (STC/MS) series. The bulletin board was set up as a method of quickly disseminating information to the field-test teachers and also as a communication tool to facilitate discussion among the teachers and curriculum developers.

This poster-presentation examines whether the bulletin board was successful as a tool for curriculum development. It focuses on two main areas. It examines the efforts by the facilitator to accommodate the variation in technological backgrounds and abilities of the group and to maintain the bulletin board's effectiveness throughout the lifetime of the project. Secondly, this paper will explore patterns of use of the bulletin board and the content of messages posted in a curriculum development environment.

Developing a Digital National Library for Science, Mathematics, Engineering and Technology Education: Building upon NEEDS—The National Engineering Education Delivery System

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Abstract: A Digital National Library for Science, Mathematics, Engineering and Technology Education is envisioned as a one-stop shop for digital learning resources to support a wide range learners from K-12 through higher education and beyond. With funding from the National Science Foundation, we are developing an Information Portal into Science, Mathematics, Engineering and Technology Education (SMETE) based upon our past five years of experience developing NEEDS, a digital library for the engineering education community. This digital learning space supports cataloging, searching, displaying and reviewing digital learning materials from target SMETE disciplines. We will demonstrate the Information Portal, see www.smete.org, and present our findings about the SMETE community's views regarding the potential value of a digital library for SMET education; level of probable use, as well as how community members envision using it; and type(s) of editorial oversight needed.

PAMA Courseware:

Learning the Psychological Analysis of Human Task Performance

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The PAMA courseware provides an introduction to the theory and practice of work and organizational psychology. The courseware will be made available in a digital learning environment that can be approached via the Internet and Intranet. First, PAMA provides an introduction to models of work and physical and psychological health. It also provides methods of psychological analysis of human task performance, as well as practices of professional skills. The introduction to theory and research is included in electronic books that contains additionally educational matter. In addition, PAMA is designed to support the development of professional skills that are required as a work psychologist. Using a case-based learning application (via Intranet), the course provides the opportunity for students to act as a work analyst and to learn that job analysis.

Collaborative Online Instruction for the Teaching of Internet, Language and Culture Skills from a Distance

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Abstract:
When you can't bring students to your campus for a high quality face-to-face cultural and language learning experience, can you effectively take the experience to them, thousands of miles and many time zones away? This is a question TESOL (Teachers of English to Speakers of Other Languages) educators around the world are asking themselves, both because of and in spite of the current state of computer-based technology. At the University of Oregon's American English Institute (AEI), our Intensive English Program has developed a successful model where our instructional services have become an integral component of distance education courses with non-U.S. institutions. Course objectives are established each term, and appropriate computer-based technologies are selected and used to help reach those goals. Faculty from the two institutions work in tandem through the planning, implementation and evaluation phases. This session will describe the pedagogical, logistical and administrative underpinnings of these courses. Examples available through the http://darkwing.uoregon.edu/~aei/senshu.html web site.

Value Chain Of Functional Interactive Product Models In E-Business

Jorma Palo & Pekka Parnanen, CYBELIUS Software, Inc., USA; Mikko Kerttula, VTT Electronics & Infotech Oulu, Finland

Enabling technologies, like Internet and advanced prototyping techniques have opened new possibilities for companies and their business activities.

Web-enabled *virtual interactive virtual product models* can be benefited in different business activities to implement E-Business solutions that includes strategic new ways to handle activities like distributed product development, web based marketing, e-commerce, training and service as well as support to distribution channels and partners.

Virtual prototypes can be benefited both in company's activities from concept design to customer service, and in customer's side starting from initial need for some goods and ending in receiving help from the supplier. Very small size interactive virtual product models with real behavior offer undisputed benefits compared to current static or animated 2-dimensional presentations on the web.

For more information please contact jorma.palo@cybelius.com and visit our Virtual Gallery at www.cybelius.com. Real business. Virtually. Interact to understand.

The Shuffler:
Software for a World-Wide-Web Based Form Routing System

DEMONSTRATION

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Abstract: The Shuffler is a software application created to help remove the conventional shuffling of paper from the routing of forms in the workplace. It is designed to run entirely via the WWW, either on Intranets or using encryption on the public Internet. The software allows a set of administrative offices to create, edit, route, verify, and archive paper forms. It includes a security system to authenticate the identity of the users as well as to authorize them. The system software is designed to be as generic as possible in order to allow it to be used by any office as well as on almost any computer and operating system. The purpose of this poster/demonstration is to present an applied view of the various functions of The Shuffler.

Creating Computer Based Learning Artefacts For Implementation In The United Kingdom's National Grid For Learning As A Third Year Interactive Multimedia (BA Hons) Degree Project.

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Abstract:

This poster session is designed to showcase how students enrolled on a BA(Hons) course in Interactive Multimedia can participate in a government educational initiative (the UK's National Grid for Learning) while fulfilling degree requirements. The Web based work that the students developed demonstrates how the concept of a national educational resource can be used in teaching and learning for all levels of education.

From an instructional point of view the project was an excellent one that allowed students to control a 'real world project' and at the same time be involved in teaching the use of interactive multimedia to a teaching professional. Technology students tend to forget that the rest of the world isn't as technically 'savvy' as they are. This brief forced them to step back and take a look at the user population.

The Web and Meeting Documents

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Abstract: Formal meetings are a universal form of group interaction required in all types of organisations. Such meetings typically have the following features: meetings are driven by an agenda, involve a chairperson and secretary and require minutes to be generated to summarise the meeting and yield actions to be carried out by participants. The agenda and minutes are the formal documents that are the important foundation of these meetings. Methods for creating, archiving, accessing, retrieving, manipulating and distributing these and other types of documents for a meeting provide great scope for study on the highly relevant Web platform. Very little work has been done with regard to formal meeting documents and the Web, one of the few examples being that of Raikundalia (1997, 1998).

Value Based Computing

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Value Based Computing is the next phase in the evolution of technology. Once your technology is in place, how do you maximize its effectiveness? How do you get the most value for your investment? School need to understand how to fully utilize applications that exist today; to integrate disparate systems, and to make modifications in their work environment that allow them to fully benefit from the potential of technology.

Most schools use only a fraction of the computing power available to them. They employ multiple applications and databases that are not integrated, hold duplicative information, and are not customized to user needs. These "islands of information" become sources of frustration to end users who can not easily get at the information they need. Finally, many school organizations have processes that are inefficient and ineffective so that the application of technology only automates the inefficiencies. Nothing really gets better.

Value Based Computing is a response to these and many other common problems. Solutions promise to make schools run more efficiently and more effectively with existing resources. The methodology for **Value Based Computing** is simple and straightforward:

- **Utilization** – focuses on maximizing the features of programs already in place to help users work more efficiently.
- **Integration** – targets "islands of information" and converts them to easy to use analytical and reporting tools.
- **Modification** – centers on modifying the workplace, work habits, and workplace culture to insure efficient and effective processes.

Student attitudes towards Web-based learning: an action research project

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Abstract: Applied Information Science and Environmental Issues, a project-based, web-integrated course, is a class for first-year Japanese college students with three main objectives: build environmental awareness, develop computer skills, and expand English language skills. In planning the class, the authors incorporated an on-line action research project to help formatively evaluate the students' perceptions of the web-integrated course design as well as the web-based delivery of the course materials. Students responded to weekly online feedback logs that focused on student attitudes and reactions to the course. Interpretations of the feedback logs influenced not only the implementation of the course as it was taught, but also the redesign of the course for the following semester. A description of the project and poster presentation is available at <http://www.miyazaki-mic.ac.jp/classes/fall99/sci151/webnet.html>.

Cooperative Web of Knowledge Construction

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Abstract

The purpose of this work comes from the necessity of teachers at several levels and areas with an open environment where it is possible to get a dinamic and cooperative structure. The main goal develops an special environment in the Web that should helps a fast courses's creation, based on a lot of small modules previously wrote by different authors. Trouhgh this purpose we used the map concept strategy and some ideas based on software reuse. A formal and an informal description, using the object oriented language UML and the OOSE (Jacobson) are been applied, in the specification of the environment. At this moment, a specific tool helps the integration of the modules and semi-automatic courses generation, that is being developed.

Developing Digital Media Materials – A Team Approach

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Abstract During 1998-99, BYU Broadcast Services Division developed a digital media teaching resource for faculty and students of Civilization 201/202 courses at BYU. A project team was organized with 1 full time project manager, a part time associate project manager, graduate student instructional designer, and 6-8 student graphic artists, researchers, production managers, and technical assistants. During the production of more than 6000 digital media objects, the team also created a multimedia project development process that has become a model for future courseware development efforts at BYU. Project conclusions highlighted the following recommendations: Capture what is currently being done in the class. Then establish course instructional objectives with the faculty member. As the team works to assess digital media needs, identify areas or concepts that difficult to teach using traditional methods. Digital images used to replace slides in the classroom were no more effective than the slide itself. But they were often easier to use and thereby were of value. But digital media proved to be particularly effective when trying to teach difficult concepts. Poster will include demonstration of process.

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Specification of the Distance Orientation Support System (SAAD): An Ergonomics Approach

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Abstract

The application of Internet as a media for distance education has been showing an exponential growth, generating the necessity for new configurations of the existent media, as well as a new parameter of analysis. This work presents the planning process and construction of a WWW site for academic orientation at a distance, to be used in the M.A. Program in Logistics offered to students of PETROBRAS – the Brazilian Oil Company – following ergonomic criteria. The intersection between the areas of CMC, Software Ergonomics, and Academic Orientation was the selected approach to build a site that can answer the assessed needs and expectations of the potential users. The result of this work was a project specification presented to the Distance Education Laboratory of the Federal University of Santa Catarina – UFSC, to be used in the program above quoted. This paper describes the experience of the generation of the *Distance Orientation Support System* (SAAD) specification.

The Development of a Curriculum Template for Applied Problem-Solving in Distance Education Learning Communities

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Abstract: The purpose of this project is to create and evaluate a low cost multimedia curriculum tool (hybrid CD-ROM with Internet capabilities) that will assist students, particularly distance education students, to (a) apply and reflect upon what they have learned with instructor support and feedback, and (b) participate in a community of learners who engage in constructive problem-solving. The project will support nine field-tests across five disciplines found in postsecondary education. Given formative data at the conclusion of each field-test, the curriculum will be refined and readied for the next field test. Dissemination of the findings and use of the curricular tool and process is an important aspect of the project. Staff working on this innovative project hope to provide postsecondary educators with a low-cost, practical, and replicable solution to the problem of getting students to apply what they have learned in their coursework and to participate with communities of learners.

Acknowledgements:

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Regional Identity Preservation Using The Internet

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This work presents two different educational projects that have involved two secondary schools in Italy (students aged 17-19). The aim of these projects is the preservation of the regional identity. The Internet plays an decisive role in the globalization of information, but it is important to defend our traditions (i.e. the regional cooking, the play and the poetry in dialect, and so forth). In the first project, scholastic year 1996/97, 30 students of a fifth class at Vocational Institute in Verbania (Northern Italy) have created a collaborative hypertext (using HTML language) to introduce some particular aspects of the new province of Verbano Cusio Ossola (e.g., its geographical characteristics, the gastronomic local specialities with the tasty recipes). The final work has been available for two years for the Internet "surfers".

The second project, scholastic year 1997/98, has been developed by 29 students of a Technical Institute in Verbania. This collaborative hypermedia (developed in HTML), that also contains the tape recording of the play and poetry in dialect, can be read at the Internet address:

http: // www. verbania.alpcom.it/verbania/Alpen/inie.htm

It can be browsed from our emigrants that can not come back in Italy, and in this way they can preserve the memory of their origin. These educational projects are two examples of "learning by doing" environment, because the students have learnt some their unknown traditions while they were developing the hypertexts.

Utilizing Desktop Video-Conferencing and Web Delivery for Faculty Technology Training

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The ability of higher education faculty members to engage in professional technological development is still limited by time constraints and fear of appearing incompetent. The purpose of this project is to overcome these problems by utilizing and subsequently evaluating desktop video-conferencing and web-based delivery as arbiters of collaboration and agents for change in an academic world where change does not come easy. The training and evaluation project takes the approach of utilizing low-cost desktop video-conferencing, data collaboration, and web-based delivery systems to deliver technology instruction to our fellow colleagues. Several technology workshops have been designed, delivered via desktop video-conferencing and the World Wide Web, and subsequently evaluated. These workshops were delivered via web-based software using synchronous and asynchronous instruction using: (a) multipoint video; (b) multipoint audio; (c) instructor-led and narrated web touring; (d) web-based pre-, post-, and in-class materials; (e) shared whiteboard; (f) text chat; and (g) interactive instructor questioning.

Return on Internet Investment $(\text{ROI}^2)^{\text{TM}}$

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Abstract: Organizations building online solutions are beginning to recognize the value of measuring Return on Internet Investment $(\text{ROI}^2)^{\text{TM}}$ early. Determining methods to measure ROI^2 needs to be one of the first major steps in the up-front planning process, and continually evaluated and applied throughout the entire project lifecycle. ROI^2 provides a foundation for organizations to determine the success of their online business solution and develop future plans to bring the project to the next level. It should be stressed that ROI^2 is the end result of an effective Web strategy. A Web strategy should support corporate objectives and should have a clear plan for measuring its effectiveness. Identifying planned benefits and a means to measure them is a critical first step to measuring ROI^2.

Course Management: A Complete Asynchronous Environment Architecture in Education

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Abstract: Technological improvements have enhanced our range of educational experiences with such things as distance-learning. The education systems of today are needed to be supported by new architectures for managing the courses, instructors, students, performance records, for grading homeworks and exams, for supporting assessment, legacy systems, and security. We have developed a multi-tier architecture which integrates back-end tools and systems with commodity interfaces. Data at the back-end databases transformed into knowledge at the front-end browser through a hierarchical middle-ware using various object web technologies. We implemented an asynchronous open information access environment. This asynchronous resource is used to support traditional classroom and interactive synchronous lessons offered using TangoInteractive. It evolved with the needs, reached a large audience, 450 users, including on-campus and on-line distance courses. This paper presents a technical architecture overview and discusses its functionalities gained from our experiences.

Breaking the shackles of the physical page: Site level authoring for XML using ASML.

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A major problem with web authoring today is the page-at-a-time HTML approach. As web sites grow larger and more complex, it is essential that tools treat the site as a single, large, hypermedia document. Even newer technologies such as XML are still shackled by this dependence on the physical page relationship. This poster describes the use of ASML site-level processing in conjunction with XML content to author web sites as a single hypertext document. ASML treats a web site as a single large hypermedia document. Within the structure of a site, content can be several modules, corresponding to a logical hierarchy of the data. This approach to authoring simplifies the production of sites that present content in different forms and allows for simpler management of link and final presentation format consistency.

Owen, C. B. (1998). Automatic Site Markup Language. Available at: http://www.devlab.dartmouth.edu/asml/

Owen, C B, Makedon, F, Frank, G, and Kenyon, M. "ASML: Automatic site markup language 1.03," Dartmouth College Technical Report PCS-TR97-309, February, 1997.

Connect-2-Tomorrow: Internet Access and Email in a Children's Hospital

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Abstract: The Connect-2-Tomorrow project is a federally funded grant which utilizes Internet connectivity to provide children receiving care at University of Mississippi Medical Center (UMMC) the opportunity to continue their education and maintain contact with peers, teachers, family members and newly assigned keypals. The Blair E. Batson Hospital for Children in conjunction with the Mississippi Department of Education (MDE) is working to ensure that along with the medicine that heals the physical body we not forget about the healing of the mind and heart. Patients within the hospital have the opportunity to email classmates, "meet" new friends through a keypal program and participate in their classrooms using video conferencing equipment. In addition, problems and solutions regarding confidentiality and firewall protection to provide access for a multi-platform system will be presented in this poster demonstration.

A Modern Knowledge Infrastructure: Properties and Capabilities

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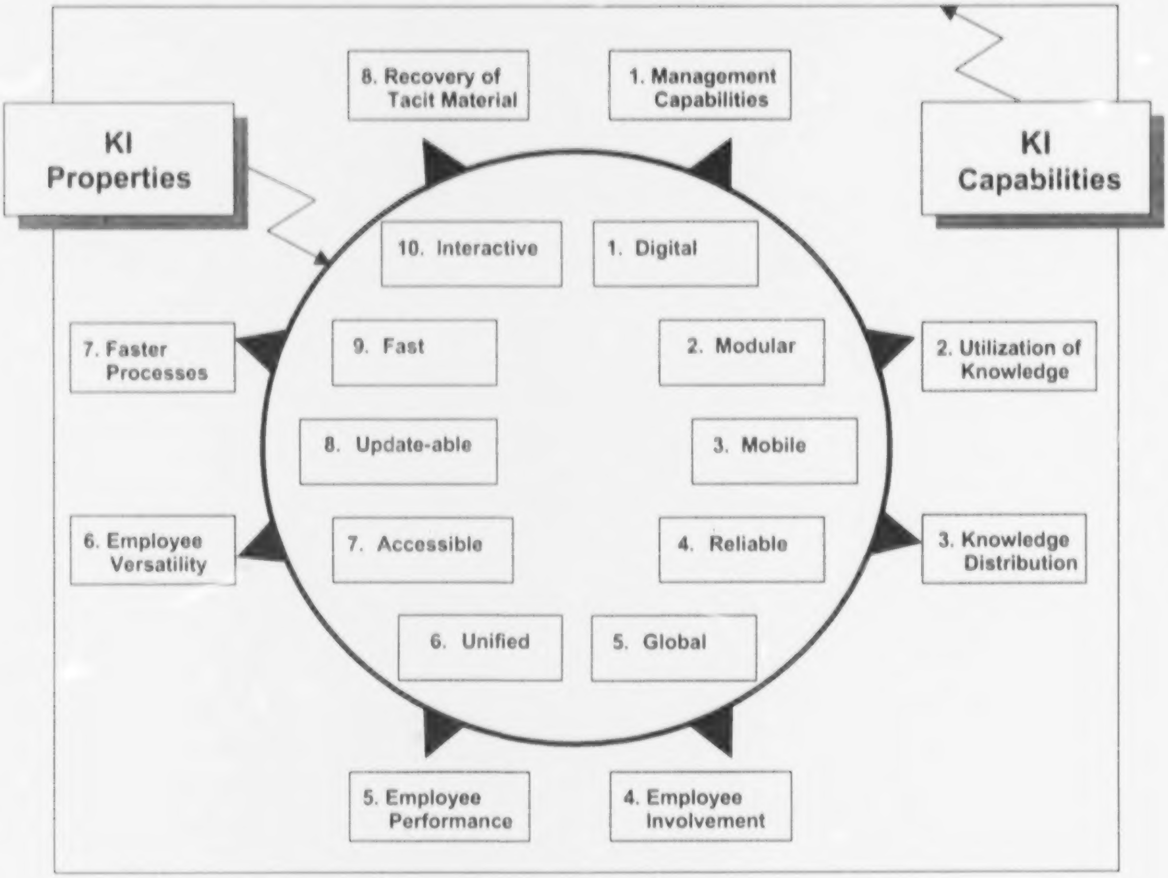
A modern knowledge infrastructure has specific technological properties that enable organizations to function with far greater efficacy. It is digital, modular, mobile, reliable, global, unified, accessible, update-able, fast, and interactive. These ten properties of a modern knowledge infrastructure in turn enhance the capabilities of the knowledge management system. The strengthened capabilities of the infrastructure lie in: (1) management potential; (2) utilization of knowledge; (3) knowledge distribution; (4) employee involvement; (5) employee performance; (6) employee versatility; (7) organizational processes; and (8) recovery of tacit material.

These capabilities yield benefits to the organization as a whole and to individual organizational members. Capabilities 1, 2, 7, and 8 enhance primarily the organization; in contrast, capabilities. 3, 4, 5, and 6 enhance the organization, but through the individual. A knowledge infrastructure thus works to promote individual organizational members, understanding that the organization as a whole is most likely to benefit through the advancement of the individual.

Knowledge Infrastructure (KI)
Properties and Capabilities


KI Properties
KI Capabilities
8. Recovery of Tacit Material
1. Management Capabilities
7. Faster Processes
2. Utilization of Knowledge
6. Employee Versatility
3. Knowledge Distribution
5. Employee Performance
4. Employee Involvement
10. Interactive
1. Digital
9. Fast
2. Modular
8. Update-able
3. Mobile
7. Accessible
4. Reliable
6. Unified
5. Global

Standards for Educational Technology – IMS

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1. Introduction and Background

The last decade of the millennium has seen rapid progress in the development of learning technologies, giving hope to many that we may be approaching the realisation of a vision of an educational landscape in which education providers form virtual partnerships to deliver distributed provision. A landscape in which learners sharing the same learning programme can do so across fading boundaries of time and space.

Throughout that same decade however, some of us have been pointing out that this vision requires more than just good learning technologies - it requires *interoperable* learning technologies. This is because the vision is predicated on education providers (and learners) being able to piece together resources from diverse sources, and present them as coherent integrated packages in which the components interact to provide rich educational experiences. Without interoperable courseware components this kind of "pick and mix" facility is just too difficult for most people to bother with. But, to achieve interoperability amongst courseware components requires technical standards. Until now, there have been none.

The word is now out however. The world is waking up to the problem of incompatible learning technologies and the need for technical standards to enable them to interact. There are now three major initiatives attempting to address the problem of technical standards for learning technologies:

- IMS is a consortium with scores of academic, government and commercial partners including all the leading computing industry companies.
- The IEEE working group P1484 (now renamed the Learning Technologies Standards Committee - LTSC) is another prominent initiative with widespread support.
- The European Union standardisation mandate in the domain of "Learning and Training Technologies & Educational Multimedia Software".

Even better, the three initiatives appear to be talking to one another and attempting to harmonise, and even build upon, each other's efforts. In addition, they are making great efforts to build on top of well known software standards, such as CORBA, DCOM, HTTP, and XML.

This Special Interest Group discussion focuses on either (or both) of two issues which I believe are vital to the success of these standards-forming initiatives:

1. The generation of a wide range of innovative, futuristic scenarios involving learning technologies - i.e., "fleshing out the vision". This is important because scenarios are what drive the requirements gathering process. They form reference points which can be used to verify the outputs from standards projects.
2. A discussion of how the outputs from the projects can best be implemented in the delegates' host institutions/organisations.

2. References

Note: Dates in square brackets following a URL are the dates the author last visited the URL.

European Union Memorandum of Understanding (MoU): http://www2.echo.lu/telematics/education/en/news/mou.html [8th July 1999]
European Union Standardisation mandate to CEN, CENELEC and ETSI. http://www2.echo.lu/telematics/education/en/news/mou1198/moucen.html [8th July 1999]
IMS. http://www.imsproject.org/ [8th July 1999]
LTSC - Learning Technologies Standards Committee of the IEEE (formerly P1484 working group). http://ltsc.ieee.org/ [7th July 1999]

The University of New Mexico

Centre for
Learning And Research
in Integrative Studies

est. MCMXCIX

Building a Web-based Research Center: Ideas for the UNM-CLARIS Web

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Abstract: The UNM-CLARIS Web is a new research center, designed to exist solely on the World Wide Web, dedicated to collecting and conducting research on the new and expanding field of individualized studies in higher education. Many specialized and innovative degree programs exist throughout the United States that allow undergraduate/graduate students to design their own degree curricu ums. However, those programs are not efficiently connected in a pro-active way sharing ideas or resources for the students benefit. Our research center is building a digital *interactive* encyclopedia and listserv that will help students, faculty, and staff in interdisciplinary and individualized degrees to make the most of their opportunities creatively. Creativity is the key to student development and post graduation marketability. We intend to create a forum for exchange (ideas, strategies, and research) that will continue to develop and strengthen the various programs that exist, as well as provide guidance for new/changing programs.

The Virtual High School

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Abstract: The VHS (Virtual High School) project is a collaborative of high schools from across the United States. In exchange for contributing a small amount of teaching time, a school in the collaborative can offer its students over one hundred NetCourses ranging from advanced academic courses to technical and specialized courses. Each school provides a VHS site coordinator who is responsible for project management and support of teachers and students at their local school. The VHS grant provides training, software, and technical and administrative support. Each school can enroll up to 20 students for each course a teacher contributes. Quality of teaching is maintained by requiring each teacher to successfully complete The Teachers Learning Conference, a graduate-level NetCourse designed to give participants exposure to the best educational strategies and technologies for NetCourse teaching. The VHS will become a membership organization after the funding ends.

Directed Web Searching

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A few years ago we were asked to make a staff development presentation at a rural school district in Central Illinois. We were asked to focus our presentation on helping teachers to use the Internet as an information-gathering tool for both themselves and their students. As the presentation got underway, we decided to pick a safe topic like "Bears" as a search term for demonstrating how a search engine operates. To our surprise, the search results returned several links to web pages that were highly inappropriate for our audience. This incident led to a discussion with the teachers about the dangers of allowing students to indiscriminately browse the Internet for information. At the time, our advice to the teachers was to combine the use of Internet blocking/filtering software with some careful monitoring of student Internet activities. This advice led to some further discussions about the inadequacy of this approach for protecting students from the "dark side" of the Internet. Some of the teachers with classroom Internet experience related their futile attempts at trying to monitor an entire class, while others told "war stories" of students by passing the blocking/filtering software.

Architectural Detailing at Random: An Interactive Artist-Made Book On-Line

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Abstract:: *Architectural Detailing at Random* is an interactive artist-made book that was first conceived of in 1986 after shooting Polaroids of "details" encountered doing house renovations in a small Wisconsin town, Random Lake. Because local people talk about what goes on in this village as being "at Random," I imagined a book focused on architectural details of a house renovated "at Random." I loved moving the Polaroids into different visual combinations and wanted to design a book that invited viewers to devise their own variations. This sense of a book without finite limits is another play on the title "at Random."

It wasn't until I started working with web page design in 1995, however, that I found a form that would allow for the interactivity I imagined. It had taken nearly a decade for the Internet to develop to a place where I could realize my earlier concept in physical media.

DIALANG - An Internet-Based System For Diagnostic Language Assessment

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DIALANG is a European project which develops diagnostic language assessment tools in 14 European languages. These languages include all the official EU languages as well as Irish, Icelandic and Norwegian. The assessment materials will cover all levels from beginners to advanced, the skills being reading, writing, listening, and speaking, structures and vocabulary. The project will complement traditional approaches to language assessment by exploiting the use of new technologies in assessing the use of language.

Characteristics of the system:

- An assessment system, based on a shared foundation (assessment framework and test specifications) and constructed by assessment experts from all EU countries.
- A diagnostically oriented system, and one of its purposes is to promote diversified language learning in Europe.
- Self-assessment as an integral part.
- Internet delivery. (Existing computer-based assessment systems usually run on single machines or on local networks.)
- Adaptiveness over the Internet. (Adaptive language assessment systems are being, but the Internet is a new context for adaptive engines.)

Data Integrity and Web-based Experiments in Cognitive Psychology

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Java and Macromedia's Shockwave technology allow interactive cognitive psychology experiments to be delivered via the worldwide web. The existence of sites established for educational support has raised interest in the prospects for "research-grade" web-based experiments. In order to provide research-quality data, web-based experiments must answer questions that include the accuracy with which tachistoscopic displays can be presented, the accuracy with which reaction times can be measured, the control of the experimental environment, and falsification of subject variables. This SIG discussion will address issues regarding the integrity of data collected from web-based cognitive psychology experiments such as: Control over the selection of research participants, Control over the commitment of research participants, Control over the truthfulness of research participants, Control over ambient conditions, Effect of bandwidth on stimulus timing and accuracy of determination of reaction times, and Effect of machine differences on stimulus timing and accuracy of determination of reaction times.

Applying the Methodology and Art of Making Films to Producing WWW Videos

Ray Thompson, University of South Dakota, USA

The presenter was recently assigned the course 'Production of Digital Audio and Video Resources'. Because he didn't have formal training in the production of film and video projects the presenter developed a professional development plan with the following learning goals: (1) operate a variety of cameras and lighting equipment; (2) set-up shots; (3) direct a scene; (4) record sound; and (5) use digital editing equipment. The presenter attended a four-week experience at the International Film and Television Workshops in Rockport, Maine where the skills listed above were a taught. This poster session will be used to share what the presenter learned about applying the methodology and the art of filmaking to producing WWW videos. The presenter has established a web site to make contact with others who are producing web-based videos. The web site includes discussion board and video segments demonstrating specific film making techniques as applied to web videos.

DeltaM - a Decision Support System for the Public Participation in Decision Making in Spatial Planning

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In the highly urbanized and densely populated western part of the Netherlands the space is scarce and therefore under the constant pressure of multiple claims. Changes in the use of space are often the result of interaction between designers and decision-makers. Currently used procedures in plan evaluation and approval in The Netherlands do not properly support this interaction. The process of a plan development and approval is long lasting and inefficient, based on the old-fashioned unicentric model of decision-making. The changes in modern society reflect in growing need for other models than those of hierarchical type.

The aim of this research is to develop a tool, a Decision Support System (DSS) for the *competent citizen* in the *pluricentric* society. The system named DeltaM is meant to help individual users to choose appropriate plan among many and to estimate the consequences of the choices before they take part in collective negotiations with other decision-makers.

Using Technology to Reach Students, On Campus and Beyond

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Abstract: At Thunderbird, our library patrons include many different types of key constituents. We constantly strive to reevaluate how, when, and where this diverse group of patrons acquire knowledge so that we can provide them with the instruction and skills that they need to be lifelong learners and users of technology. Students must learn both the value and the skills of locating information in an electronic environment. In the International Business Information Centre (aka, the Library) at Thunderbird, we use various methods to provide students and alumni with the knowledge and the skills they need to locate international business information from print resources, electronic databases, and the Internet. In my presentation, I will discuss and demonstrate the methods that we use to ensure that students have access to the most current, comprehensive, and valuable business information, both from on campus and beyond.

Similar Syntax Search Function on Web Based Japanese Educational System

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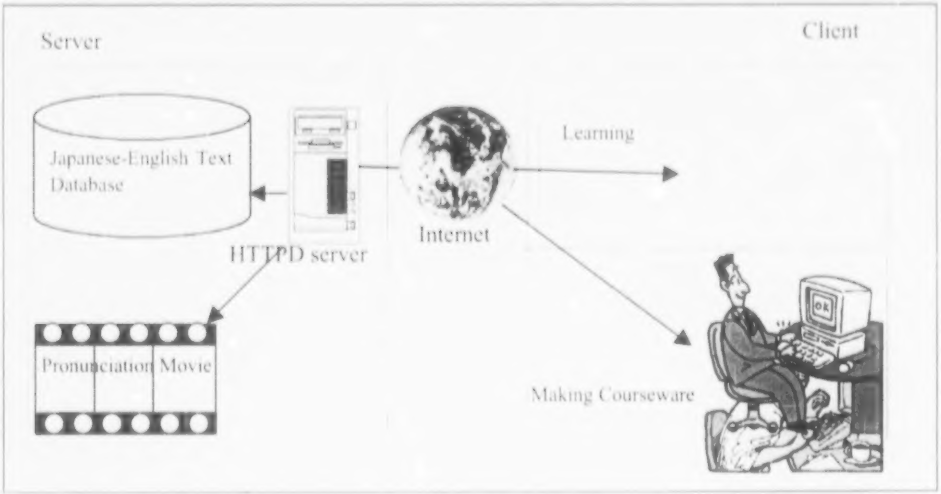
There are growing number of foreign people who are interested in learning the Japanese language. However, there are not enough teachers and courseware of Japanese education. One of the problems is a wide range of interests: daily conversations, business correspondences, technical documents, etc., which cannot be covered in a single courseware or a class. Making a textbook with a comprehensive set of sample sentences is also time-consuming. Another problem is the number, shapes, and pronunciation of the characters used in the Japanese language, which would be an immediate barrier to start reading/writing Japanese text.

We have been developing a Web Based Japanese Educational System which aims at providing an environment for both courseware builder and courseware users. Fig. 1 shows the overview of the system. In this figure, Japanese-English Text Database is used for providing students example sentences including focused words in a courseware, and for providing teachers example sentences searched by Similar Syntax Search Function.



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RAIN Network distance learning and telemedicine projects Internet content development at the Community Level -

Timothy Tyndall, RAIN Network, USA

Working with the USDA Rural Utilities Service distance learning and telemedicine program, California Department of Education, University of California Extensions and Department of Commerce/NOAA RAIN takes education resources directly into the Community at the Neighborhood level.

Our "Neighborhood Technology Master Family", "Youth Technology Corps" and "Community Technology Advisory Councils" are the tools by which we create effective, actively used Community level Internet resources. Three essential "Change Agents" within our programs.

RAIN begins use of two "Internet Bus" vehicles in September 1999. Each bus equipped with 4 computers, lending library, large screen for group teaching and satellite Internet connection. This new generation of "book mobile" takes our distance learning and telemedicine programs to rural communities and inner city projects in an essential new way, giving access to many who would otherwise not have Internet access.

Designing Web-based Image Databases To Enhance Medical Education

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Abstract: The WWW is not merely an electronic equivalent of a textbook. It can provide a dynamic interface with databases in which knowledge can be stored and retrieved in complex ways to promote educational outcomes. The objectives of this project were (1) to design an online database of pathophysiological images that would allow second-year medical students to retrieve and search for images; (2) to create an "intelligent" database that direct students to similar cases of the same disease or alternative representations of the same case; (3) to create an easy, online interface for faculty to manage the content of the multimedia database. The web browser interface was programmed with ColdFusion®. A Microsoft Access® database contained fields with information related to the location of the image, descriptors of the image, clinical and patient information, and proprietary information. Feedback from students and faculty has been very positive.

BioPsy : An intranet application for biopsychological experiments

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Students who specialize in experimental psychology are confronted with a substantial amount of technical information on the instrumentation and the design of biopsychological experiments. Although mathematics at high school level is a precondition to enter psychological education, several students have difficulties understanding these technological aspects. BioPsy is developed to support those students who are confronted with deficiencies in knowledge of physics, electronics and instrumentation techniques. It is also developed as a remedial teaching tool to update the necessary knowledge and skills. The application is additional to face-to-face teaching and can be completed at any convenient time. Multi-media elements are used to enliven the course material. The application consists of three different modules. Students can search on specific terms to look up knowledge elements. They can also complete an introductory course on instrumentation techniques. In the last module, participants can apply their knowledge in several exercises based on actual experimenting.

Information Architecture and Web-Based Instruction

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This poster session presents the application of principles of information architecture to Web-based instruction. Information architecture is the structuring of data to meet the informational and management requirements of an organization or group of people. The discipline of information architecture is informed by principles of information theory and communication theory, information design, and the findings of cognitive psychologists on perception and learning.

In this presentation, I examine relevant literature on information architecture and web site creation, consider the application of the principles of information architecture to Web-based instruction, and discuss ongoing research to evaluate the efficacy of such an application. The following topics are addressed:

- Theoretical background: communication theory, information design, cognitive psychology, hypertext theory, distance learning theory, and the social construction of knowledge
- Using information architecture to construct effective web sites
- Using web-based information architecture to assist students in their own construction of knowledge.

Students' Response to Web Based Language Learning

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Abstract

Foreign language instruction is central to the College's mission, and in order to strengthen the program, we explored how using the WWW can provide access to authentic material, offer more efficient ways to practice and test grammar, and give instructors flexibility in determining the curriculum of language and content courses.

After a semester of using the WWW in a Spanish class to supplement materials, we gave students a questionnaire to evaluate its use. They were asked to give written responses on questions ranging from their computer expertise to their understanding of the goals of the web exercises, and whether the use of the WWW should continue in language classes.

The majority of the students felt that web-based exercises accomplished stated goals which included acquiring increased confidence in reading and listening to Spanish through real life examples and exploring topics not available in their textbook.

Positive student reception of web-based curriculum indicates that, with modifications a, the use of the WWW in Spanish courses at the college should continue.

Maximizing Resources, Expanding Access and Maintaining Quality in Web-Based Courses in the Community College

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Abstract:

Atlantic Community College is a small community college, located in southern New Jersey, which offers four complete degrees via online Web-based distance learning. Developing online courses and working with others is now assuming a major role at our college. This demonstration will emphasize:

- The strategies necessary to *maximize resources*, particularly faculty expertise.
- The logistics of *increasing access* by encouraging faculty development and by sharing courses among several colleges.
- The mechanics of *maintaining quality* by following the ABC's of distance learning:
    1. Assessment
    2. Built-in support
    3. Collaboration

The strength of this demonstration will be the dissemination of practical, replicable strategies to assist schools in planning for and enhancing the online delivery of Web-Based courses. Attendees will receive workable plans, ideas and methods to maximize resources, increase access and maintain quality in online course delivery.

Using Email and the World Wide Web to Teach and Improve a New Technology-Based College Course

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Abstract: National standards have arisen in recent years to address the process of preparing teachers to incorporate technology into education in effective and appropriate ways; both pre-service and inservice teacher education now commonly include technology components. This presentation will describe the ways in which one particular College of Education in an urban setting has chosen to include technology within its required coursework, with particular attention to the ways in which Email and the World Wide Web have been used both as a teaching methodology and a means of gathering evaluative data. Details will also be provided regarding the difficulties encountered in the early stages of implementation, the ways in which the coursework has been modified, and the current results of these efforts at improvement. Our purpose is to provide an example for other teacher preparation programs considering the various options available to them in addressing technology within the context of pedagogy.

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How Computer Tools/Systems Support Cognition: An Examination of Theoretical Foundations and Design Strategies

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This poster reviews how computer tools/systems support cognition by examining the cognitive benefits of selected computer tools/systems. Earlier research has investigated this area, and the common focus has been on the interactive process between student and cognitive tools. My poster builds on this conceptual underpinning, but I go on to analyze tools/systems from cognitive perspectives. I classify tools/systems by the cognitive theories embedded in them, e.g., distributed cognition, situated cognition, activity theory and constructivism. This poster displays theories, exemplary tools, research perspectives and design strategies associated with distributed cognition and situated cognition.

Using the WWW to Guide Science Inquiry Lessons: Barriers and Solutions to Creating WebQuests in Elementary/Middle School

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Abstract: There is questionable educational benefit in elementary/middle school in having learners surfing the Web without a clear task in mind. This is a report on the barriers and solutions encountered by three elementary/middle level teachers during their creation of two science WebQuests during the WebQuest/PDN Project, a joint university/school network venture in Maine. In the development phase, the barriers to creation of the WebQuests included the following examples: a) Scarcity of Reflective Time (absence of time in a teacherÕs busy schedule for unhurried, thoughtful computer access); b) Web-Surfing Tendencies of the ÒRead and Click GenerationÓ (rapid and often unfocused web-surfing practices of students); and c) Students' Tendencies to Merely "Copy and Paste from the Web" (frequent lack of student reflectiveness and analytic ability while on the web). The teachers' WebQuests will be demonstrated, and their solutions for surmounting the above, and other, barriers will be examined.

PsychExps: A Resource for Instruction in Psychology

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Abstract: PsychExps (http://www.olemiss.edu/PsychExps) is a web-based cognitive psychology laboratory supported by the Department of Education FIPSE program and the University of Mississippi. Cognitive psychology experiments written in Macromedia's Authorware language are delivered via the worldwide web to participants, where they are executed in "non-trusting" mode using the free Authorware Web Player. After completing an experiment, the participant may choose to submit data to the publicly accessible archive on the UM server. For analysis, the data may be sorted by affiliation and date, and Excel macros are provided that separate data by participant and create a summary page. As of Spring '99, more than sixty university, community college, and high school classes had registered to use this resource. On-campus workshops are available to psychology instructors who wish to learn to write experiments in Authorware. The Principal Investigators of PsychExps will demonstrate the site and the construction of experiments at this demonstration/poster display.

The **Department of Education's Distance Demonstration Project: Research and Data Collection**

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Abstract: The Department of Education has selected fifteen participants—colleges, universities, and consortiums—for a pilot project which will assure financial aid for institutions that have a large number of students participating in distance education, including web based instruction. As part of this pilot project, the Department of Education has required a substantial research and data collection component. The University of Maryland University College has been selected to participate as a distance demonstration university. The methodological design involves comparing distance and classroom based programs. The Department of Education has provided a data collection spreadsheet to collect data on Distance and classroom based students. Conceptual and methodological issues such as how to categorize students that are not purely distance or classroom based as well as how to track a cohort that changes categories will be presented. Initial data that touch on issues of diversity, access, and quality will be exhibited

The Fruits of ADDIE: Instructional Products of a Web-Based Distance Education Seminar Using Virtual Reality

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Virtual reality (VR) is the ability to immerse the computer user, as an active participant as opposed to a passive viewer, in a computer-generated experience [Grimsdale 95]. The use of VR applications in web-based distance education is still in its infancy. Instructors and instructional designers do not have specific models, let alone many case studies, upon which to design and implement web-based distance instruction using VR applications. Therefore, the problem arose when instructional designers were called upon to design and develop distance instruction for a one-hour web-based seminar using a VR application. Designers followed the ADDIE model of instructional design [Rossett 87] to address the problem. The purpose of this demonstration/poster session, therefore, is to showcase the instructional products that were designed and developed for the virtual seminar as well as inform the audience of how the ADDIE model was used by the instructional designers.

References

[Grimsdale 95] Grimsdale, C. (1995). Virtual Reality Systems. Cambridge, MA: Addison-Wesley Publishing Company.
[Rossett 87] Rossett, A. (1987). Training needs assessment. Englewood Cliffs, NJ: Educational Technology Publications.

Internet Technology Links Three Generations: A Case Study

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Abstract: The Internet is taking root with a wide cross-section of Americans. In just a few years, the Internet has emerged from near obscurity to being a common household word, largely due to the replacement of difficult computer language with user-friendly graphical user interfaces with point-and-click interactions (Ryder & Hughes, 1998). This case study in progress will take an in-depth look at three generations of a family and their experiences with learning and using Internet technology. A sample of the research questions that are being investigated include: (1) Is there a difference in the learning styles, attitudes, and achievements of the three generations? (2) What challenges are faced by the participants? (3) What kinds of instruction are most helpful to the participants? Reference: Ryder, R.J., & Hughes, T. (1998). *Internet for Educators*. Upper Saddle River, NJ:Merrill.

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Designing and Implementing a Web-Based Course

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Abstract: The Web has attracted teachers with promises of access, interactivity, ease of use, dissemination, and a potential universal presence in the lives of students and teachers. This presentation will describe experience learned in developing and delivering a Web-based course currently offered via the Internet with emphasis on what worked, worked well, caused problems, and failed miserably. The presenter will provide an overview and hands-on demonstration on his Web-based course at the University of Southern Mississippi [*http://dragon.ep.usm.edu/~yuen/teaching/toe648/toe648.htm*].

CGI Application for Automated Creating and Updating of Subject-Oriented Internet Resources Databases

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Abstract: A directory of Internet resources by subject is an important section of any academic library's Web pages. A common problem faced by many libraries is the difficulty of updating such a page. At CSUSB library, we have developed a large "Internet Resources by Subject" database. Fourteen quick-launching Perl CGI scripts have been written to create a user-friendly interface to update the database, allowing all subject specialists to participate easily. Without HTML experience, a librarian can create or delete directories or sub-directories, add or delete Internet links, and add or change descriptions. The librarian just copies and pastes the URL and the description, then clicks the "Submit" button. The CGI script executes and generates new HTML pages dynamically. Files can be edited far more quickly than by traditional methods of HTML editing and FTP publishing.

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